

Nonlinear Combustion Instability in Liquid-Propellant Rocket Motors

Samuel Z. Burstein and Wallace Chinitz

Third Quarterly Report

to

Jet Propulsion Laboratory

April 30, 1968



GPO PRICE \$
CFSTI PRICE(S) \$
Hard copy (HC)  Microfiche (MF)  ff 653 July 65

Mathematical Applications Group, Inc.

180 South Broadway

White Plains, New York

	N 68-3140	) 5
ī.	S . (ACCESSION NUMBER)	(THRU)
1	E CR-960/9	(CATESORY)
	(NASA CR OR THX OR AD NUMBER)	(CATEGORT)

Nonlinear Combustion Instability in Liquid-Propellant Rocket Motors

Samuel Z. Burstein and Wallace Chinitz

Third Quarterly Report

to

Jet Propulsion Laboratory

April 30, 1968

JPL Contract 951946

"This work was performed for the Jet Propulsion Laboratory, California Institute of Technology, as sponsored by the National Aeronautics and Space Administration under Contract NAS7-100."





### N O T I C E

THIS DOCUMENT HAS BEEN REPRODUCED FROM THE BEST COPY FURNISHED US BY THE SPONSORING AGENCY. ALTHOUGH IT IS RECOGNIZED THAT CERTAIN PORTIONS ARE ILLEGIBLE, IT IS BEING RELEASED IN THE INTEREST OF MAKING AVAILABLE AS MUCH INFORMATION AS POSSIBLE.

"This report contains information prepared by Mathematical Applications Group, Inc. (MAGI) under JPL subcontract. Its content is not necessarily endorsed by the Jet Propulsion Laboratory, California Institute of Technology, or the National Aeronautics and Space Administration."

### TABLE OF CONTENTS

INTRO	ODUCT:	ION	1
I.	FLUII	D DYNAMIC MODEL	. 2
	Α.	Finite Amplitude Transverse Waves in a Cylindrical Chamber	. 2
	В.	Energy Release in a Fluid with Finite Amplitude Waves, Simple Energy Source	26
	c.	Energy Release in a Fluid with Finite Amplitude Waves, Simple Energy Source (Including the Axial Flux Calculation)	30
	D.	Finite Amplitude Waves and Simplified Modified Godsave Analysis	32
	E.	Program COMB Status	55
II.	DROP	LET EVAPORATION AND COMBUSTION ANALYSIS	56
	A.	The Rate of the $N_2H_4/N_2O_4$ Reaction	56
•	В.	The Modified Flame Surface Analysis	63
	C.	The Reduced Godsave Analysis	72

#### INTRODUCTION

During the third quarter progress continued along two fronts, the fluid dynamic model and the flame model of droplet combustion. This quarterly report describes some of the effort that is being generated in these two model building areas.

The first section describes some numerical experiments carried out with the fluid dynamic pancake model of the combustor. The experiments include both non-reacting and reacting flow conditions. The status of program COMB is also discussed.

The second section describes recent work in producing a simplified droplet evaporation and combustion analysis. Some recent results towards completing the Peskin-Wise model relating to the modified flame surface analysis are presented.

The authors would like to again acknowledge the creative programming effort that Harold Schechter has provided during the course of this research program.

#### I. Fluid Dynamic Model

#### A. Finite Amplitude Transverse Waves in a Cylindrical Chamber

We have continued exploring and analyzing the nonlinear motion of finite amplitude waves in the transverse plane of a cylindrical channel. In the last quarterly report (number 2) we reported on a calculation which exhibited continuous behavior of the fluid properties for all time. The initial data is prescribed by relations (traveling wave solution to the wave equation in cylindrical coordinates) which are presented on page 19 of quarterly report number 2. The initial pressure field and velocity field are shown in figures 1 and 2 and correspond to finite values for the amplitude parameter in the above equations. It should be noted that to obtain the dimensional value of pressure the nondimensional pressure is to be multiplied by  $\gamma p_{\infty}$ . In this test case, however, the maximum value of the pressure is 590 psia while the minimum value is 10 psia (here  $p_{\infty} = 300$  psia and  $\gamma = 1.2$ ). The numerical values shown in figures 1 and 2 correspond to this case. For the previous reported calculation the maximum (minimum) pressure was 450 (250) while  $p_{\infty}$  = 300 psia, and there the solution remained continuous for all time.

As figure 3 shows, for the present calculation, a shock wave has formed after about 1.22 units of nondimensional time (time is normalized by  $R/a_{\infty}$  ~ .131 millisec). The wave is strongest at the wall and decreases in strength as it curves inward into the chamber. Swirls seen behind the wave are due to numerical oscillations, a

feature inherent in these finite difference equations. Figure 4 shows the strong discontinuous behavior of the velocity field in the neighborhood of the shock. Now figure 5, taken at 400 cycles of computation, is an intermediate stage of the flow field development. Two pressure peaks are evident at a nondimensional radius of R = 1 of the combustion chamber. There is also a vast region of the chamber where the pressure is approximately uniform and it is clear that figure 6 shows a strong induced velocity field which is predominently tangential in direction. The pressure field shown in figure 7 shows clearly a symmetric compression/rarefaction wave with a peak pressure of about 1120 psia. The associated velocity field, shown in figure 8, is also locally symmetric about the pressure wave. Velocities increase and then decrease uniformly in the direction of motion while the maximum velocity is at the boundary.

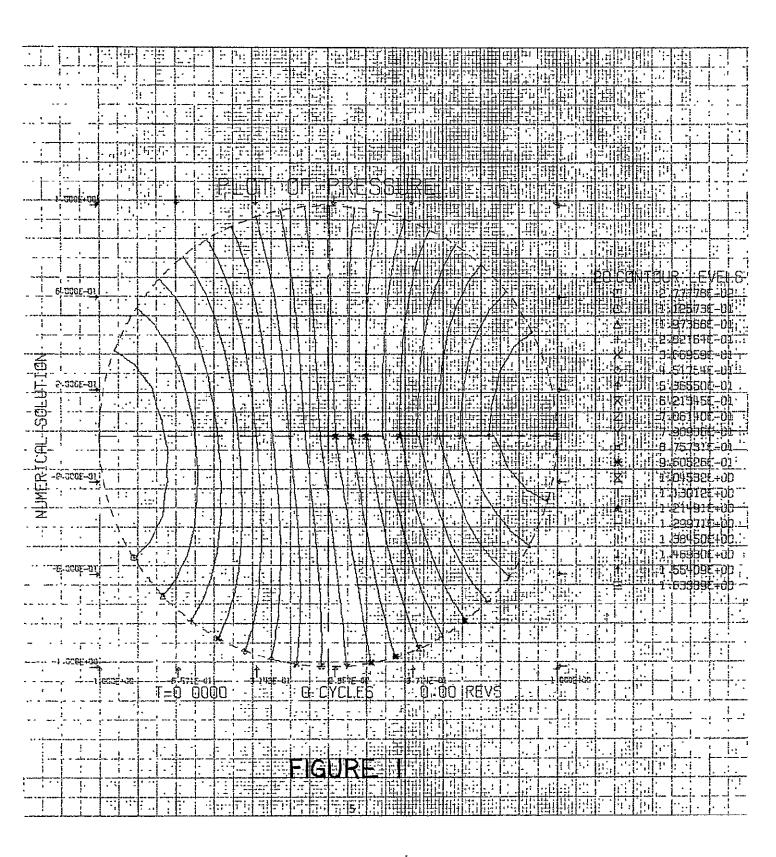
One also notices that the velocity vectors on the leading edge of the wave point towards the wall while those at the trailing edge tend to point away from the wall.

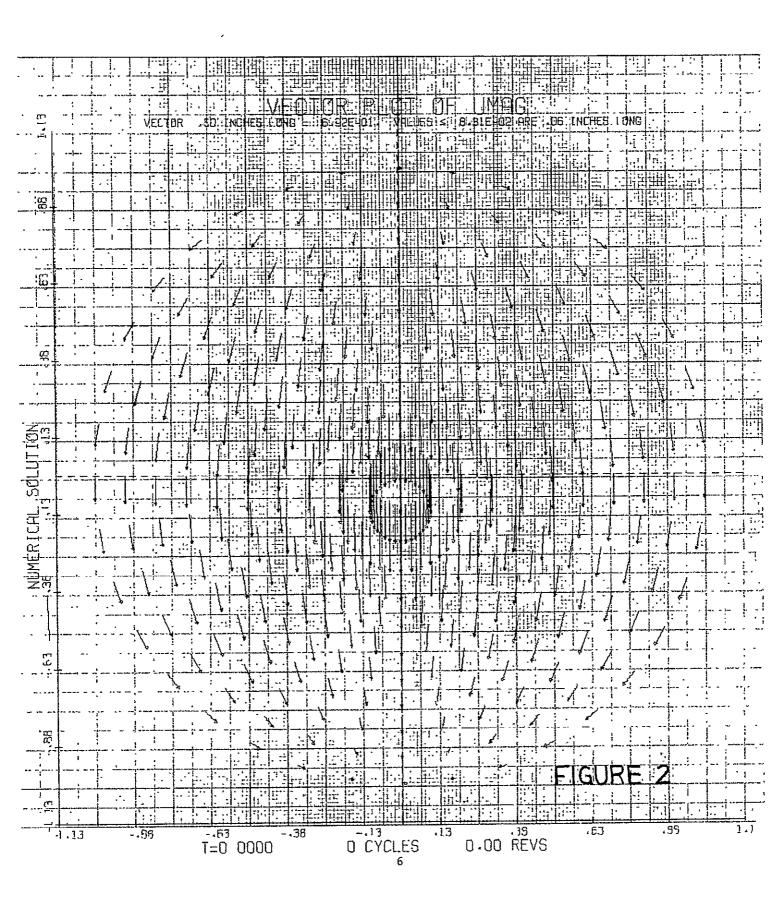
Figures 9 and 10 show essentially the same picture as in the two previous plots; here the peak pressure is 1250 psia while the minimum pressure is 160 psia. The uniform portion of the flow field has a mean pressure level of about 220 psia. The wave has now undergone about one and two thirds rotations in 0.694 milliseconds. Figures 11 through 14 again show that the wave has the same basic structure as seen before, however, the peak pressure is decreasing to 1018 psia.

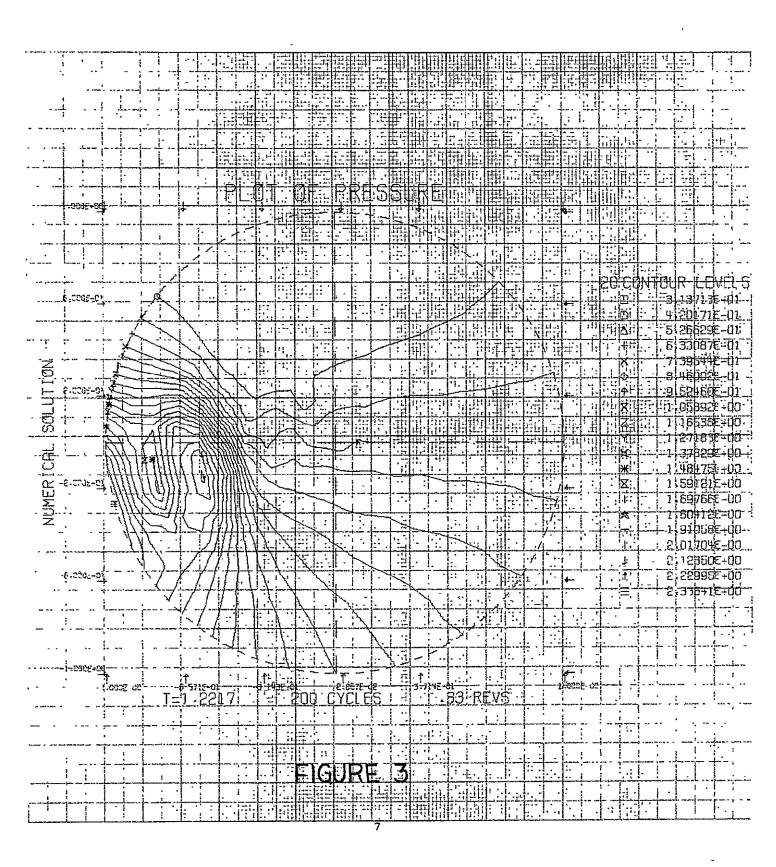
Figures 15 and 16 show the pressure field with multiple waves, waves which then seem to coalesce and lead to the flow field given by the next three figures.

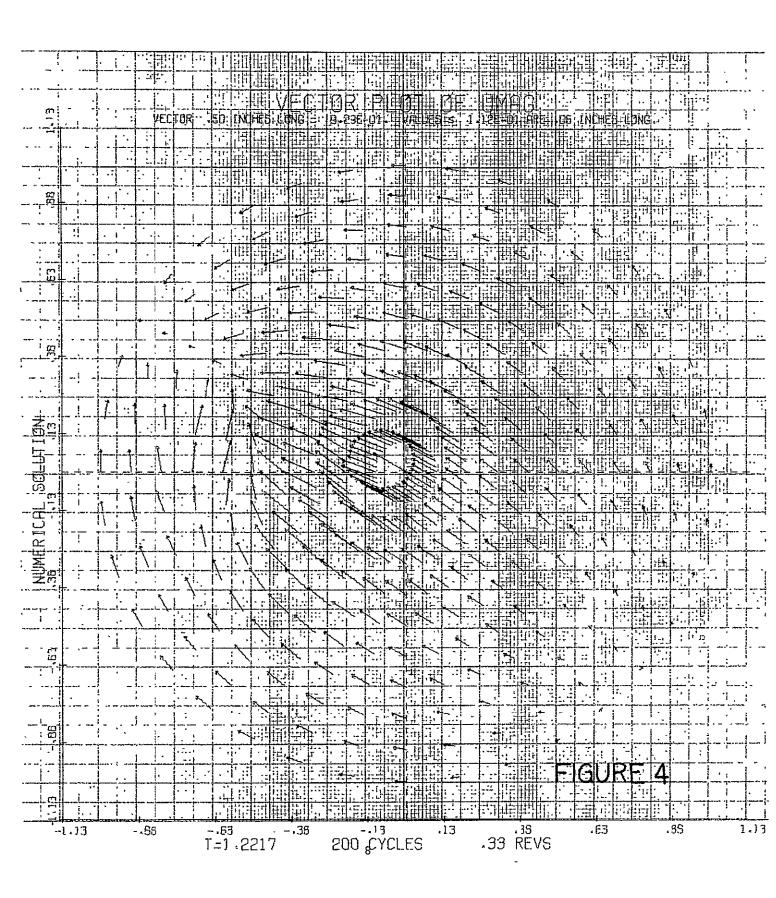
It should be noted that the 'rev' counter value given at the bottom of the accompanying figures is computed from the relative position of the velocity vector at r=0 from its starting position. For small values of the amplitude of the pressure wave, the vector rotates in phase with the wave. However, for large values of the amplitude, the fluid motion no longer is locked onto this convenient measure, but rather, there is in general a variation in phase between the rotation of the wave and the velocity vector at r=0. At 2200 cycles (figure 18 corresponds to a physical time of 1.94 millisec) the wave has rotated about 4.8 times and the maximum amplitude has gone back up to 1350 psia. It is striking that the picture of the whole flow field again looks quite like that in figure 9. Apparently the fluid exhibits time wise dependent periodic behavior with waves of finite amplitude. The average period can be computed and is found to be 405  $\mu$ -sec.

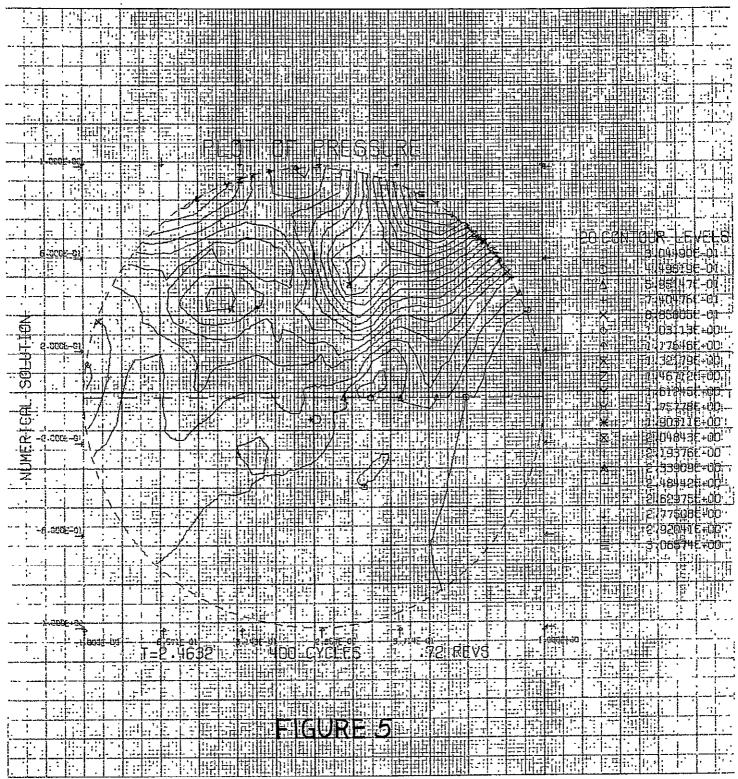
Figures 20 and 21 give the dimensional pressure on the wall of the combustion chamber for selected values of time corresponding to some of the previous figures. The curves are labeled with three numbers. The first is the nondimensional time; the second is the rotation counter enclosed in parenthesis; and the third is the computation cycle count.

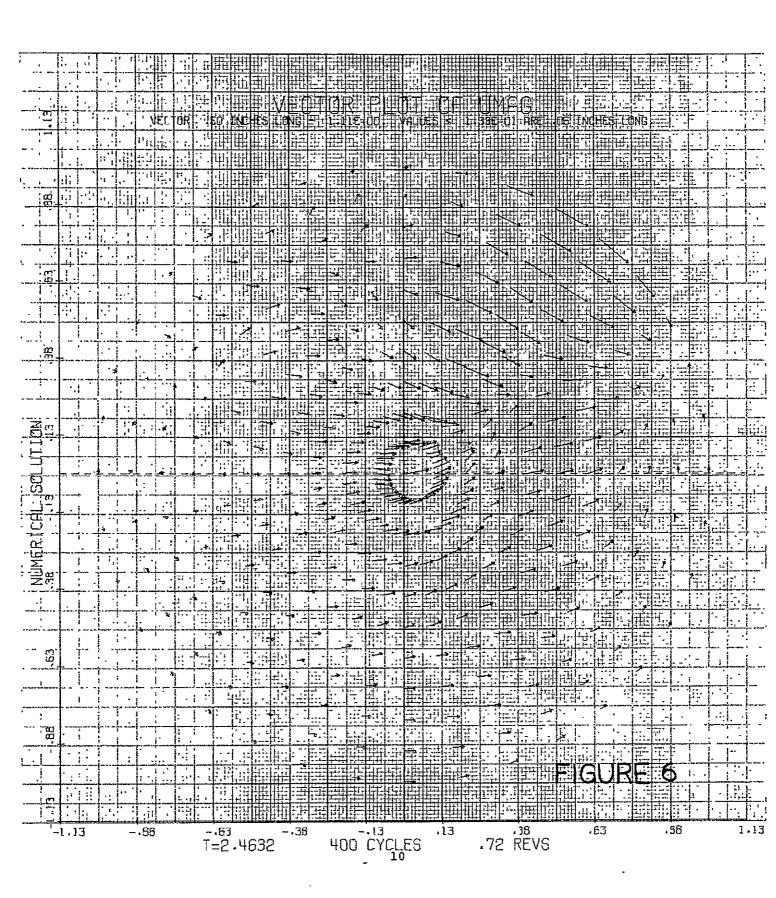


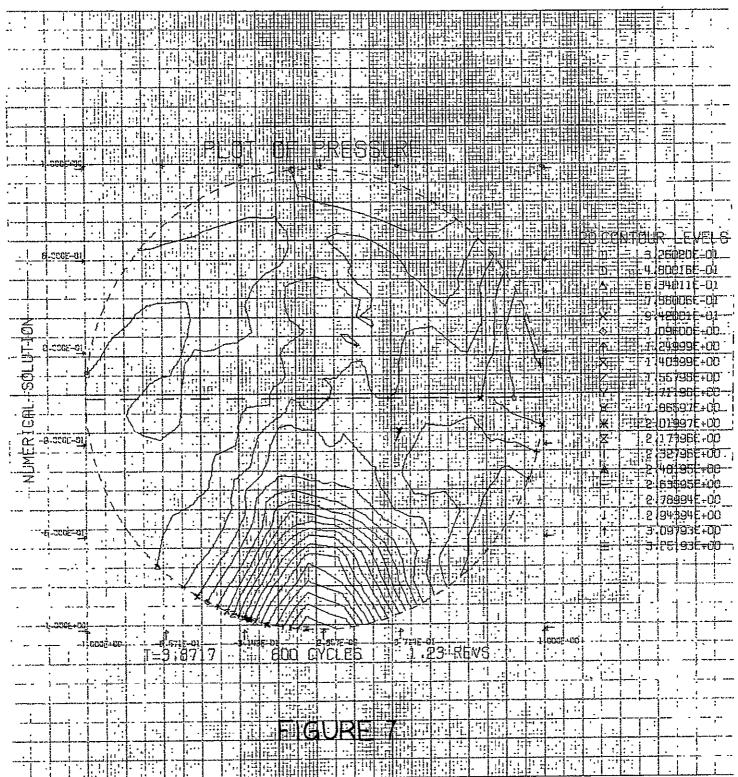


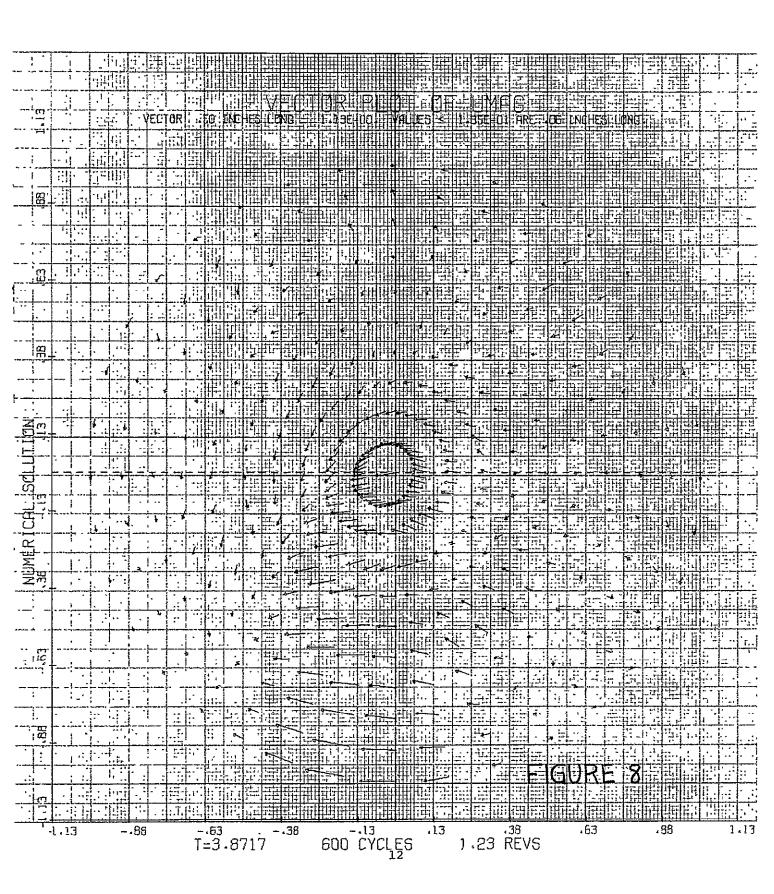


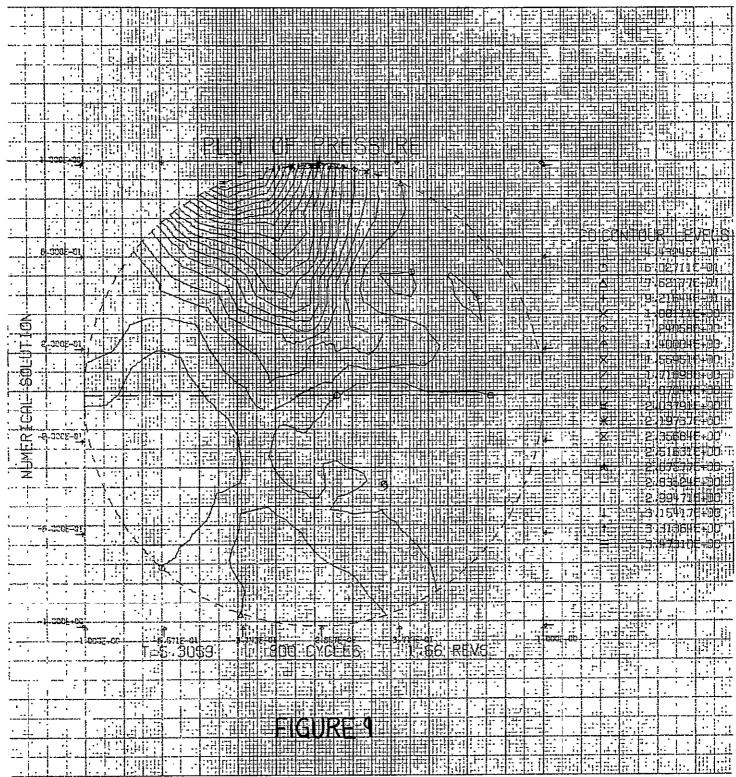


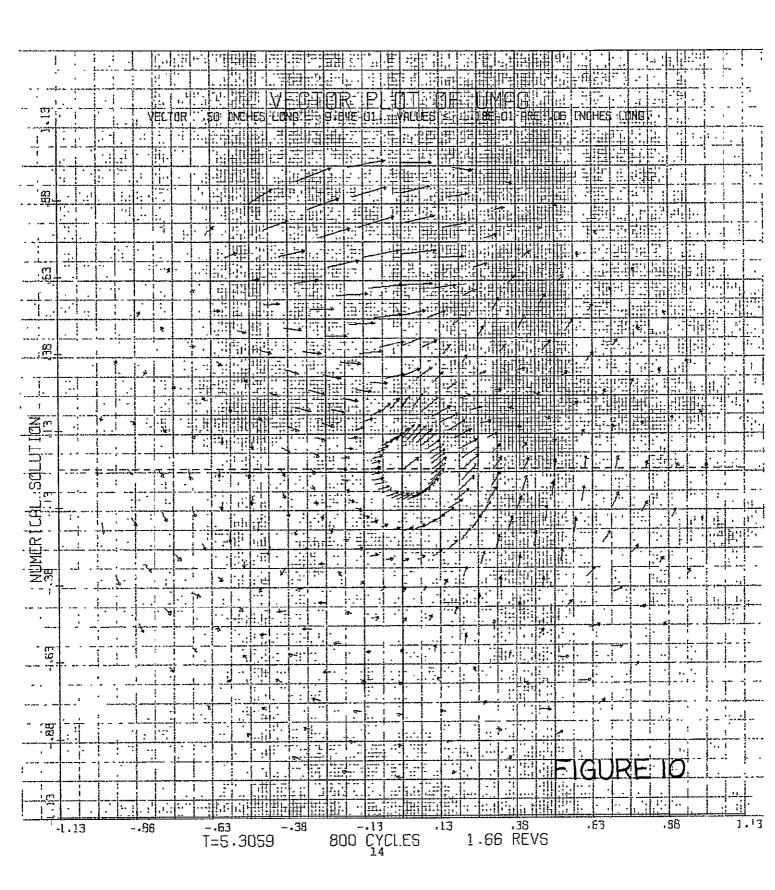




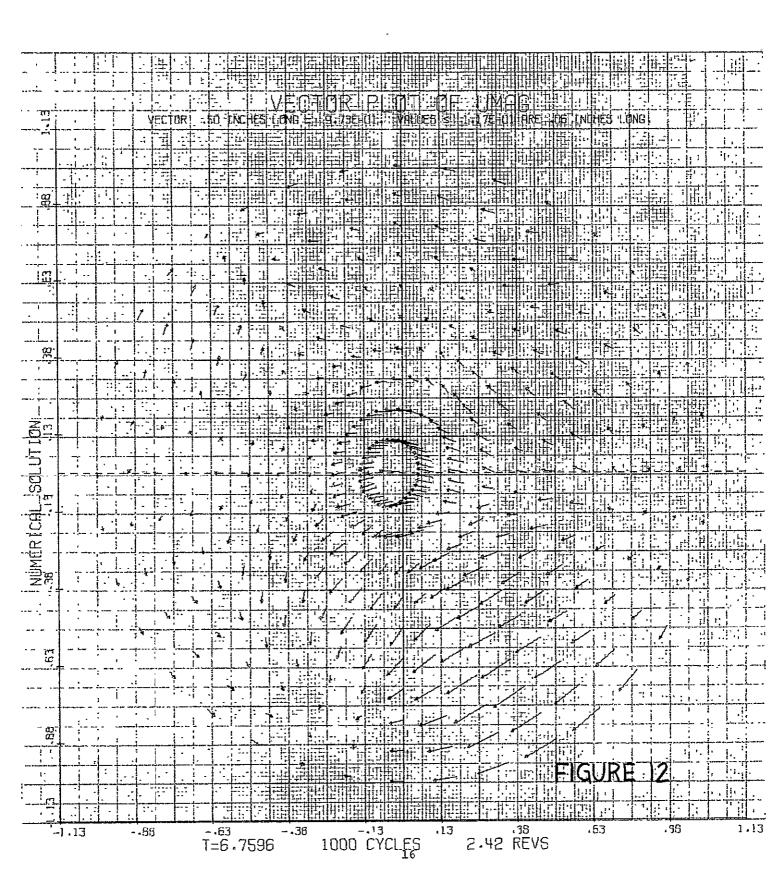


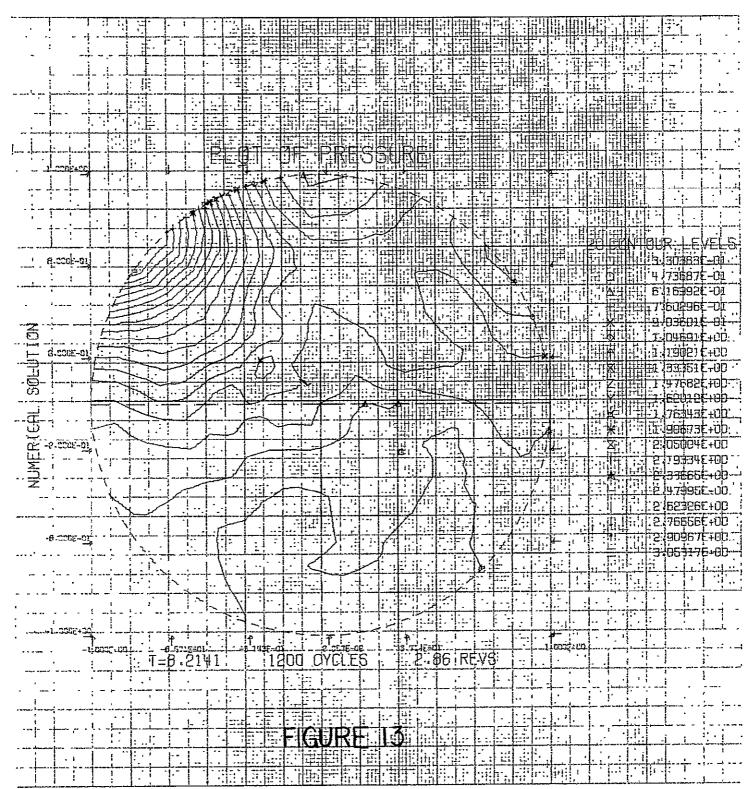


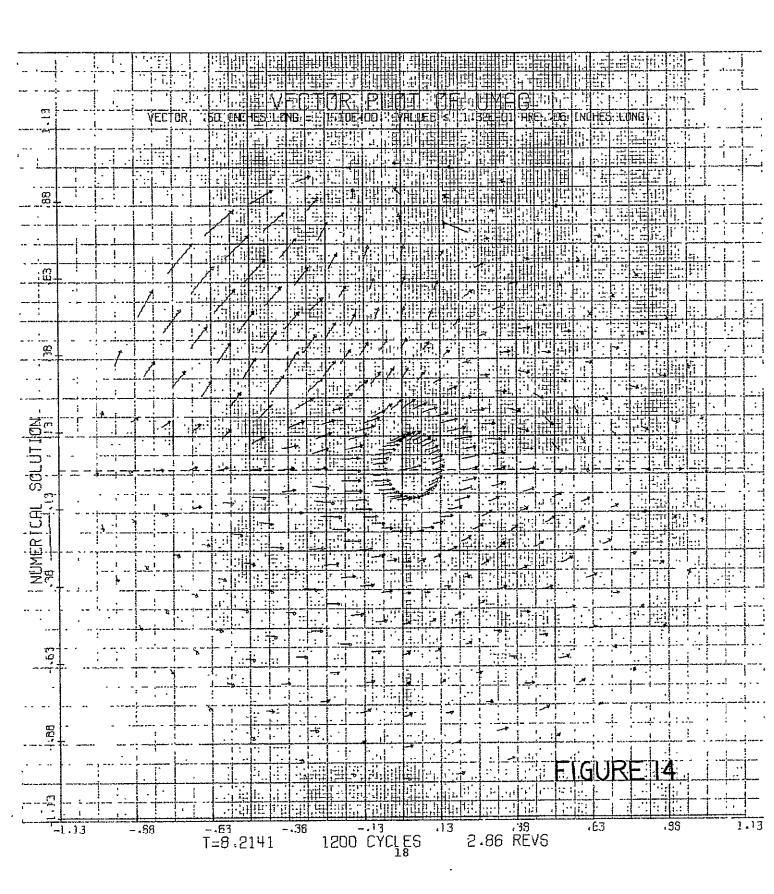


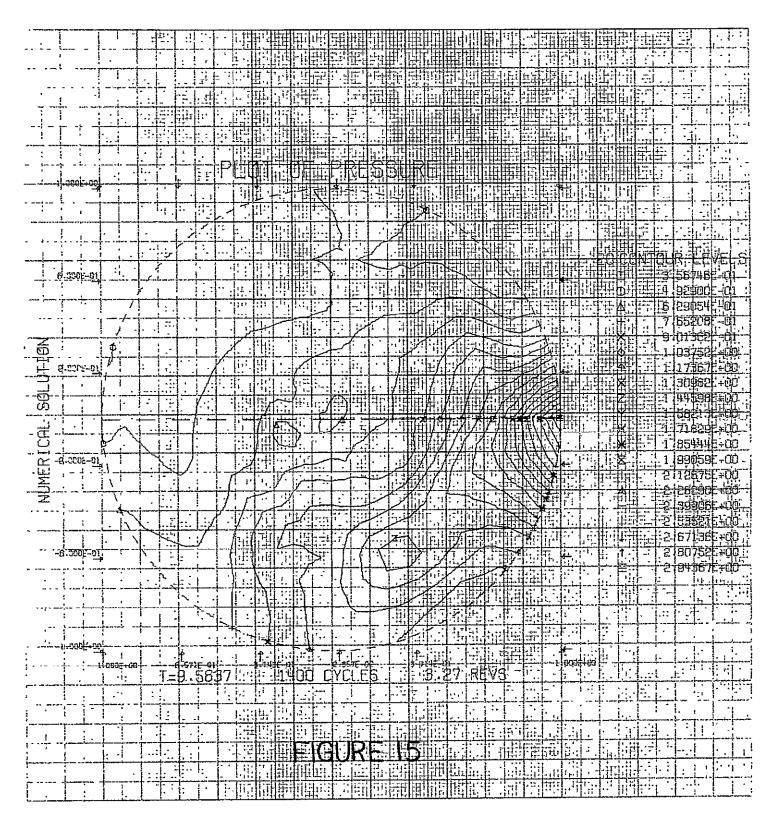


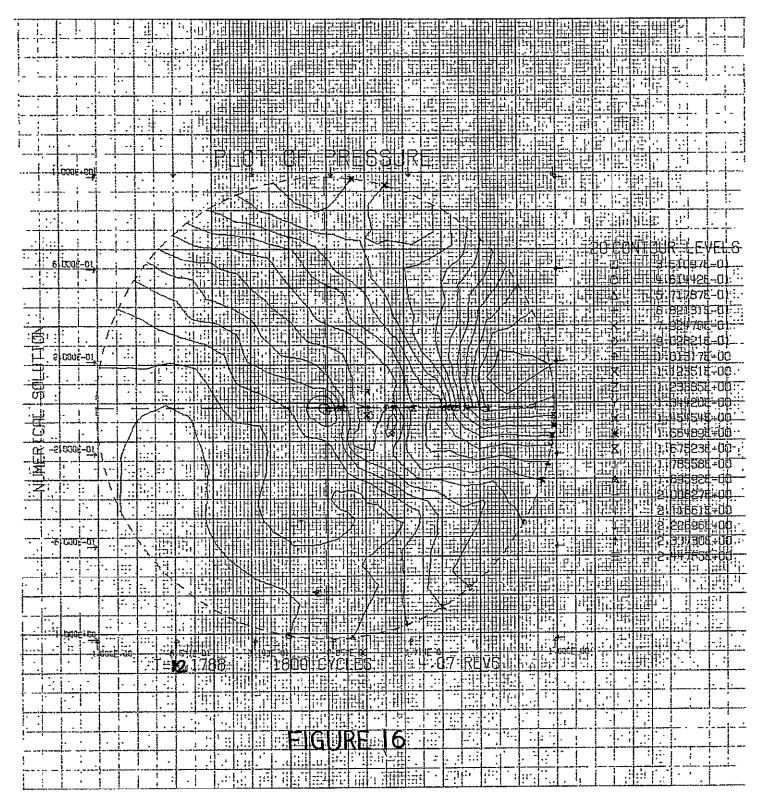
	1	- 1	1	- : : :	; 1	• • •	11:	1 1	1.	7,4		11-	111	77		##:	Ħ	71.	-=	÷ ::	1 -	::	• •		T.		Fil	4-;+:		ī:-	·. ·	#	. ]	!
			7	,1	{				::			i.			1177	,				= -	-	<u> </u>	Ē					17.	1			·声		- '-
	~ = · · · · · · ·	· ; ;	Ť	7	-	Ī	٠.:	7	1:1:	<del>                                      </del>		<u> </u>	<del>                                     </del>	Ę.	1:	11.	1.		- 1		7			- T	15	111	##			<u></u>	Ļ₃ :	<u> </u>	,-,	
:	ļ	<del></del>	<u></u>	:	}			77	- 11	<del>  '</del>			1	1 : !	詊	<u> </u>				- 1	1:-			1 1	- ;	H		<del>:-</del> -					;	
	<u> </u>			4	":"	:	.,,'	,	, li	I.	iΗ	HF	77		世				ı î			Ħ.		11				13.	-::	<u>: -</u>				 
	]		i		:. Î	٠, ا		1	15	텎	fil:	闊		11.		12.7	<b>.</b>	; ī,			† <del>-</del>		172	#		: 1	ĭĬ	11	. ;				.	•
	į :	- , , , , ,			: .1		i•1,		Ш				1	.5	ļļ.	îlî,	丑	71	1	115.			- 4	ŤĖ	H.	1	.#	11:			·	7		
	ļ	[ [-],	·	· !		• • •	` '			<b>F</b>			1,1	-		:4:	1		i			, T		<u>,</u>				77: 1:-:		τſ			寸	
	+	-				٠- تـ- إ	<del>-</del>	P					1: 1:	PI	R.F.	13		HR.	F:	174	7			1,1		1		T .	<u>                                     </u>	( <del>11</del> )	3-1			-, - i
<u></u>	1 2262-20	ļl				ļ				#1	1 6			3			-11	(E)	7				Ш	14			Щ	111	<u>                                      </u>	124,				
!		. 	-					:;:	1	11.	1		155	閆		4	4	11.3	1,	12,7			1 4				<u> </u>	###		1	لينا	<u>  : </u>	<u>i</u>	
	- :	<u> </u>	_[	<u> </u>			::[	٠,٠	,2 H	H.;			1,1		里.				<u>;</u> ;	11.		.#;	11	Ŧ.[i	.11		·Ħ	II		٠ <u>.</u> .	1, 7	: :		
	1 . ! :	ŀ		. !		سر		,	i ]	HI.	- 1	#	F.;	Ë.	λ:	ľ.,	řř	: ::	出.	14				اليا:		ij,	1	1.		ī.	ļ.,	• ;		• "1
j	: .	11.	:		~ .			217	-	[4]			讍	EF	1	1:11	-11		Ţ.	15		進		ulli					1					
		<del></del> -			جم	Ţ.		<del>``</del> ,	<del>: : .</del>	; ; ; ;	141		111	1.7	111	٠٠:	111	;;;	71;	7 77		111	77.		#	1	: 11	+0	CE	<del>[N]</del>	ЮU	R-L	<u>-£</u> √	ÆĻ
	<u>d-250-01</u>	::		ي.	 					#		144	17.	1	<del> -</del> -	<i>k</i> :	1		- +	4		- 1-1	Ħ			4			1	11-1		eoi		
·			_1			1	<u> </u>	Ьĸ		F.,		Ш	H:	- · · ·	1	У,	1.	1 4	=====		::1	严	£				- 1		<u>т</u>	F::-		102		
	1	<u>*</u>		/	<u>/</u>						{		17	<u> </u>		<u> </u>	1			::1				ij			ď	1.	<b>V</b> .,	<u> </u>	سنتسا	603		
;		./	1	. (	1.		7		17	17	1 ::	iii	1-4	_	12	ri.	.1.7	<u>\.</u> -	,	: '-		:	Π	1./1	H	11	1:1	.ji-	1 ::	<u>;::</u> !	В.	104	74	01
I ON	· · · · · · · · · · · · · · · · · · ·	1 :	-1		7		ì	× -	7.	12	h.:	Ш	11	:12	F	1	1	-7	in:		. 1	- 1		<u> </u>				111.	X :	<del>- : : ·</del>	1	111	Stite	:=U;-
ما <del>ريس</del> ،	2-326E-31	7.	<del>:  </del>	-:+	+	<del>;</del> .	1	: :	1.	恃	聞		韫	\		1:1		3" E	7	<del>: .  </del>	-1					H		<u></u>	()   	, .:	1 2	560	Act.	
-===	4-2000-21	1	-+		\	٠	- 2		:: 7:	肼			<del>     </del>	#		+			:	1		: 17	4	*111	<u> </u>			1	X	÷				
SOL	<del>:</del>		į		- <u></u>			<u> </u>	祖	V.			T\r	K.		1::1			.:`	<u> </u>		1	::[	<u> </u>		i		##	<u> </u>	;;;		910	T + 1 - 1	
	! ;	1	. ]	7.			- 11	1			1		1.	11.	11.1	::::	\; <del>;</del>		3	, i.,	1	. ‡		: :		1.		ļ:U		14	- 4		abb	100°
	7	- 1:	-1		· .	}	1.)		7	۲ <u>۰</u>	1.1	5,7	1	5	<u> </u>		7. ;	==	, A	1			ì .	4		11	11	12,1		71		961	201	יינטיב. חה
` J5	-{		Ϊ	<sub>[</sub>		-,		7		1		1,7		11		17	, ,	1	<u>.</u>		7		V	7	7		1:		*.	•:		011		
	-5-220E-2J		::	1			i.'	<u></u> .	1	++	۱.,			3	+ +	1	1.1	-			7	~;;;	<del>  ; ;</del>	4		<del>''</del>			X X			1.61		
્ર∓⊒-		3								1-14		لبنن	1	D	7	-	-						$\Gamma$	<u></u> -	7				ļ		- 12	311	69F	בינט+: ממ+:
· <u>ٿ</u> .	السين	<u> </u>						ļ	i÷	-1	<u> </u>	E.,	1 1	[:-:	17:	F/E	7.		-				74	1 1				7 - 7 - 1	<u> </u>	<u></u>	اع ا	461	81 E	:+00·
Z	;			;				ļ	<u> </u>	<u>  [:</u>	17	اغنا	-		ز_ا	<u> </u>	Æ				-				11		i. i	1		=::	2	61:1	93E	:+00 :+00 :+00
	· '	, ,		:	:			· .	:	1.	[1]	i,i:	η:	انتبا	رمبا	1:1	1	-				- ::::	+	<u>ا</u> ر:			, ,		į .	, .	5	764	050	.+00
,	1		V	:			,			T	X	1	1	- ;	1.,								干	7	- 1	31			1			912		
	-e-c::di-ci		1	<b>A</b>	.:		<u> </u>	<u> </u>	! <del>- '</del>	لمنتر	<del>}```</del> ;	144	111	) - /	1/7	17	17		( \		珒	-1	=7	•		-	:	٠.,	i <del>i -</del>			\$30		
		!		-5	~	_,		-ر-ا	يسجا	<u> </u>	-	罗	1	-7	#:	1+	<del>     </del>	-			=					-+	<del>-,</del> -	<u> </u>	<u>-</u> -		-3-	212	41E	<del>:+0</del> b
	·	, <del> </del>	:					<u> </u>	ļ'	<u> </u>	يمريا	4	1/	1	H	III.	1	FF	/		#	之丰	<u></u>	<u> </u>	- 4	1	- 11	·.		ļ	:		}	<u>. i.</u>
		:	1		·			-!t.	 ქ——	Ŀ¥	1:::	1	<u> </u>		.11	11.	1		4	$\mathbb{Z}_{4}^{\prime}$			<u>: ii</u>	<u>.: [:</u>	<u>. []</u>			1,	<u>i</u> .		<u>.</u> .			}.
:		,	;					]_	١:	174	٠. ا	1	-/	IJ.	1	<b> </b>	F-{	1:1/	10	1	. }	j	-		-11		•	÷					1	•
		[ -	-1							7	1	Ĭ	17	1	11	11.	Į.	17	a-: -			Ţ, Ţ		- 1	-11		.		;	}				!
	-i <del> -eeeF+c</del> d	<u> </u>	¦	ت ۔۔ ا					ļ	4	٠-	يستا	<del>* -</del>	4	<del>-</del>	# *	<u>*-</u>	4				· ; ;	<del>- : i</del>					<u> </u>		}			1.	
		00064	:			-57 k	E-01	<u>-</u>		3,74	Eris	155	<del>-</del>	2-3	#Æ~9    -	<u>.</u> 5		3.71	HE-D	1		긆	-1		-1-0	20\$	-01-		<u>.                                    </u>		<b> </b>			ـا: ـــ
,			<u>;</u> -	- 1	=	1	(5)	<u>, de</u>	يـــا	} 3→4	[4,[	JUG	<u> </u>	11 L	4	127	====	- 1	( • '	<u>†                                    </u>	תת	.:. .vs	4	<u>:  -</u>	-#	4	;	<u>.</u>	!	i 				
		<sup>3</sup> 1	1	[ن		<u>.</u> ,		2	<u>.</u>	1: :			1:.	E	<u> </u>	r. :					<u> </u>		_i		:1			!			i		. !	
,		!-	1	i.			) 			11.	E	12	ļ.; ;	řΞ	RI	1 .	[:	::					. أ	!	-	ļ	- '			į	;			
,	1	İ		 			••••	: 	:	1:::			1		1.	1	ļ. <del>:</del> ;			7			7	•	:	T	1.					· ·	ΊĨ	
	-44:	<del> </del> ;		.	÷			ļ	<u> -</u>	1 75	<u>                                      </u>	Ė	C	ū	Þī		11	<u> </u>		-	<del>- †</del>	<u> j-</u>		<u> </u>	<del>-   -</del>	<u>;</u> ;	1.		r !-'.		r I			! -
	<del></del>		-					ļ	Ļ	1:	[[]		Ч	닏	لكا	3	1=1	4					-	<del>: #</del>	4	4		1	<u> </u>		<del>  -  </del>		+	
; ;- · <u>-</u>		- 1	:1				:: :	<u> :</u>	<u>,`</u>	1			Li	j.	[] <del>.</del> .		<u> </u>	<u>:</u> ::	11.1	1. · · · · · · · · · · · · · · · · · · ·	: 4		- 1	. [	بإنيا		: . i : : !	.;_	<u>:</u> .	<u> </u>	<u> </u>	<u>  </u>	<u></u>	<u>.  </u>
: '		- 1			1	:	#15		<u> </u>	į!!t	1:4:		THE			1:4:		壁	1, T.	: ::		127	: <u> </u>	١. [	ī		<u>;;</u> ;	1						į į

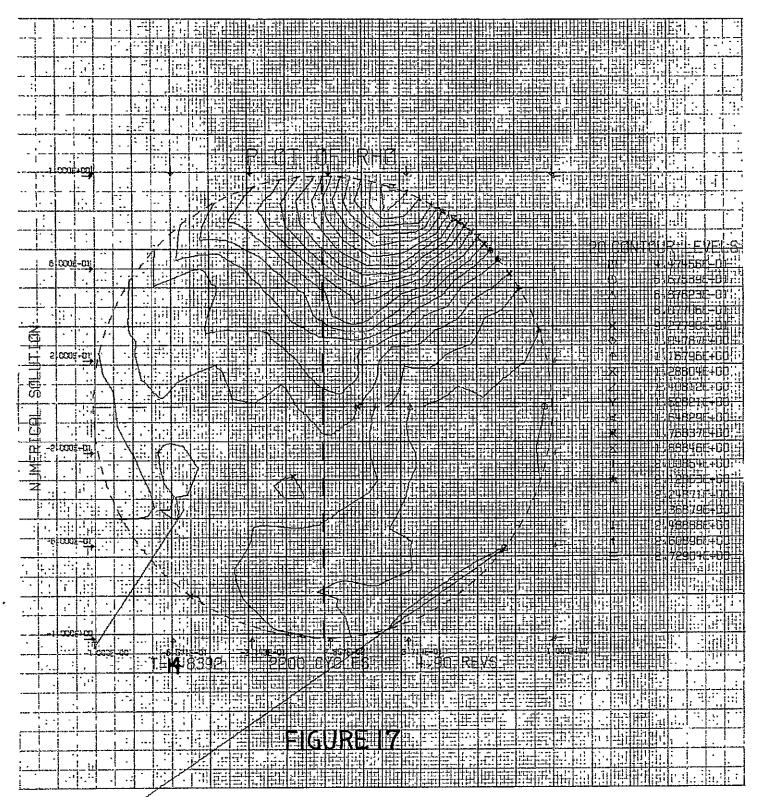


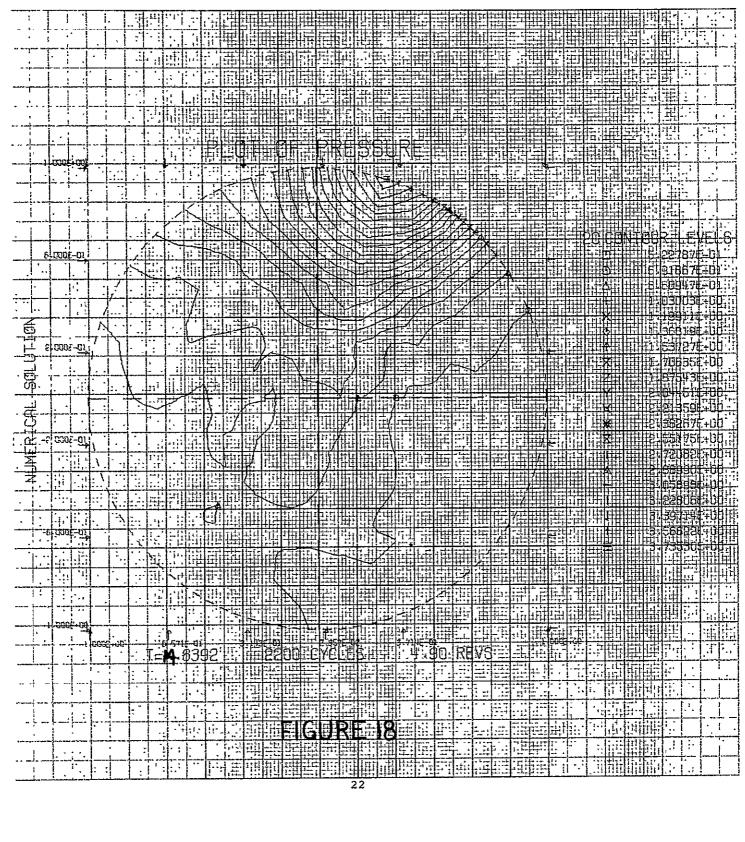


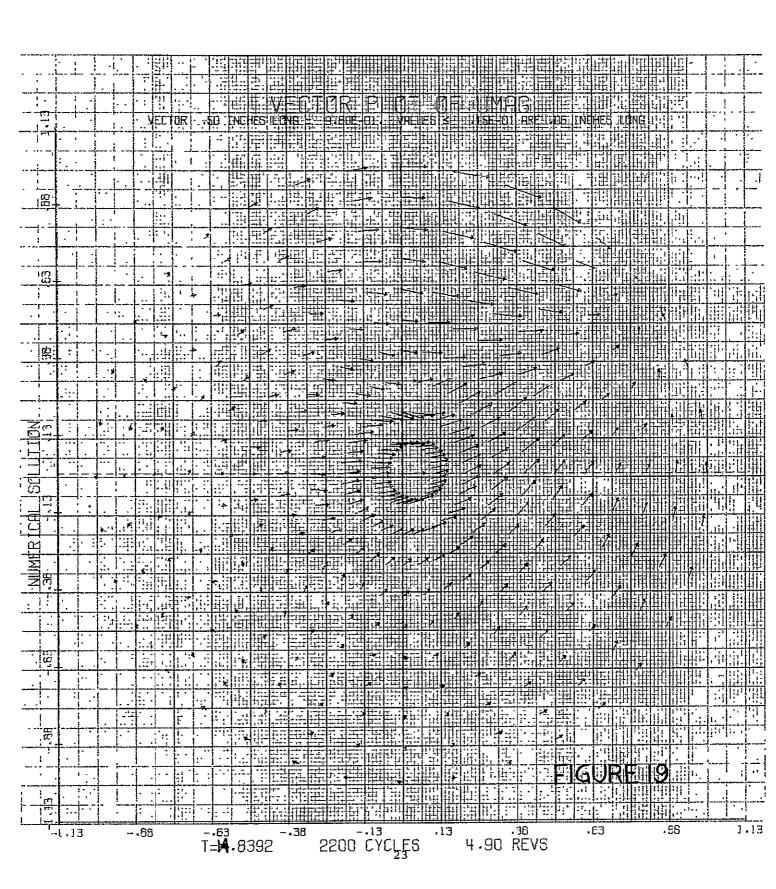


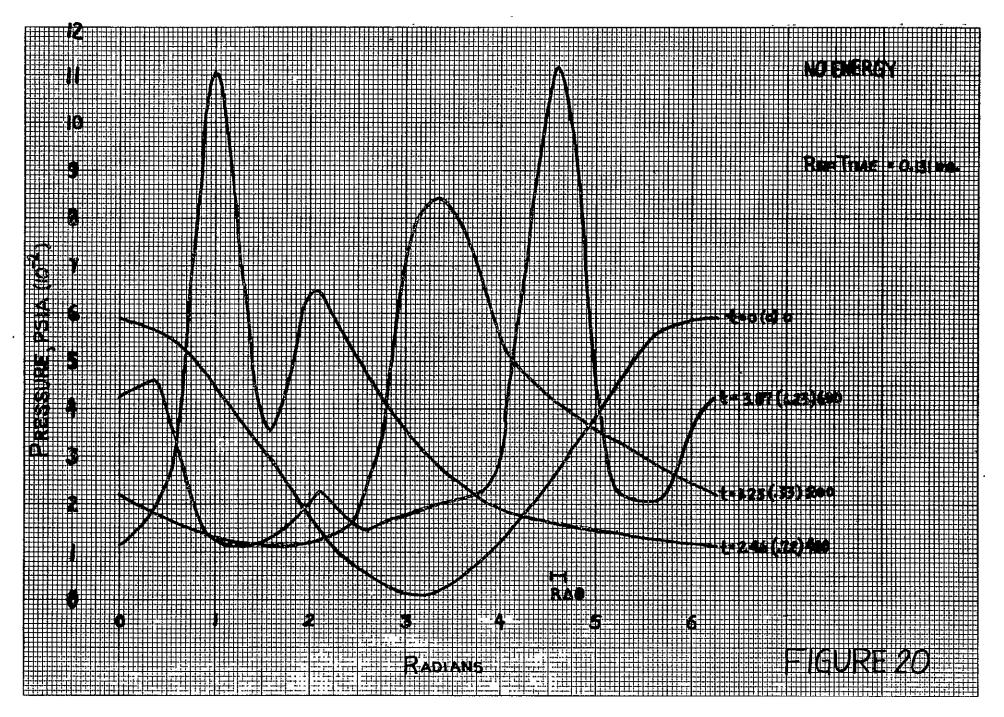


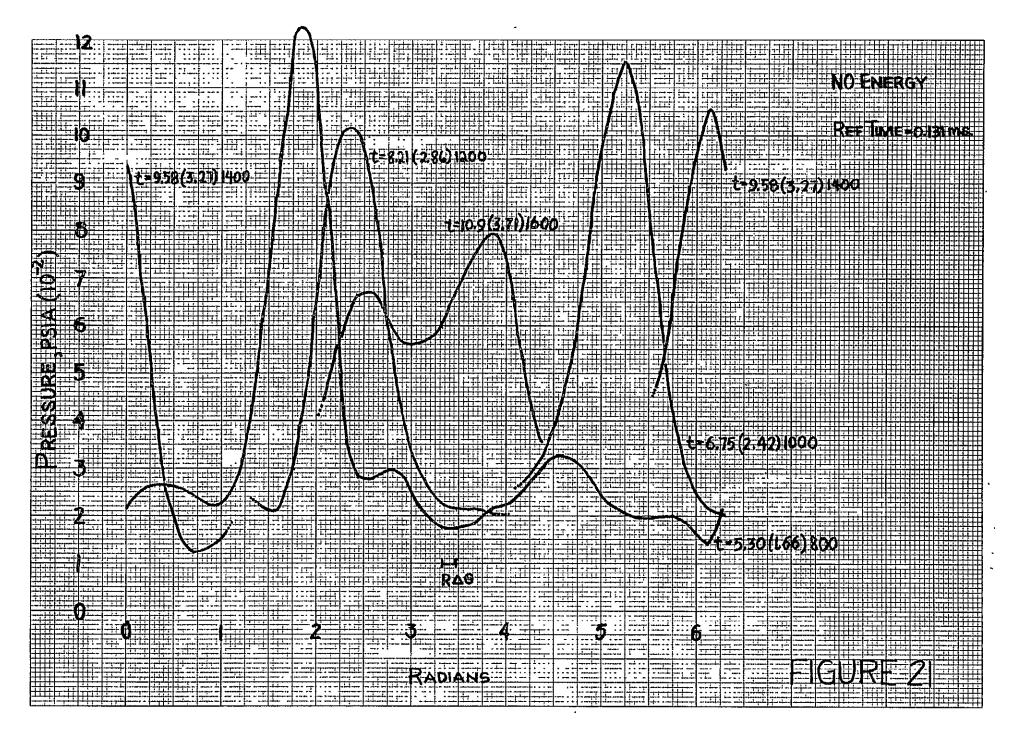












## B. Energy Release in a Fluid with Finite Amplitude Waves, Simple Energy Source

We have carried out to completion the calculation started in the second quarterly report and described on page 26 of that report.

The calculation consists of adding an energy source term to the energy equation. There is no associated mass source term in the continuity equation. The energy term is dependent on the local pressure via

$$\dot{\mathbf{E}} = \text{const} | (p-1) |^{v} \cdot \mu, \quad v = \dot{\lambda} \text{ if } p < 1$$

$$v = 1 \text{ otherwise}$$

It is also assumed that a velocity effect can be included by allowing  $\mu$  to depend on the magnitude of the velocity  $|\vec{u}|$  =  $(u^2+v^2)^{\frac{1}{2}}$  via

$$\mu = 1$$
 if  $|\vec{u}| \ge \delta$ 

 $\mu = 0$  otherwise

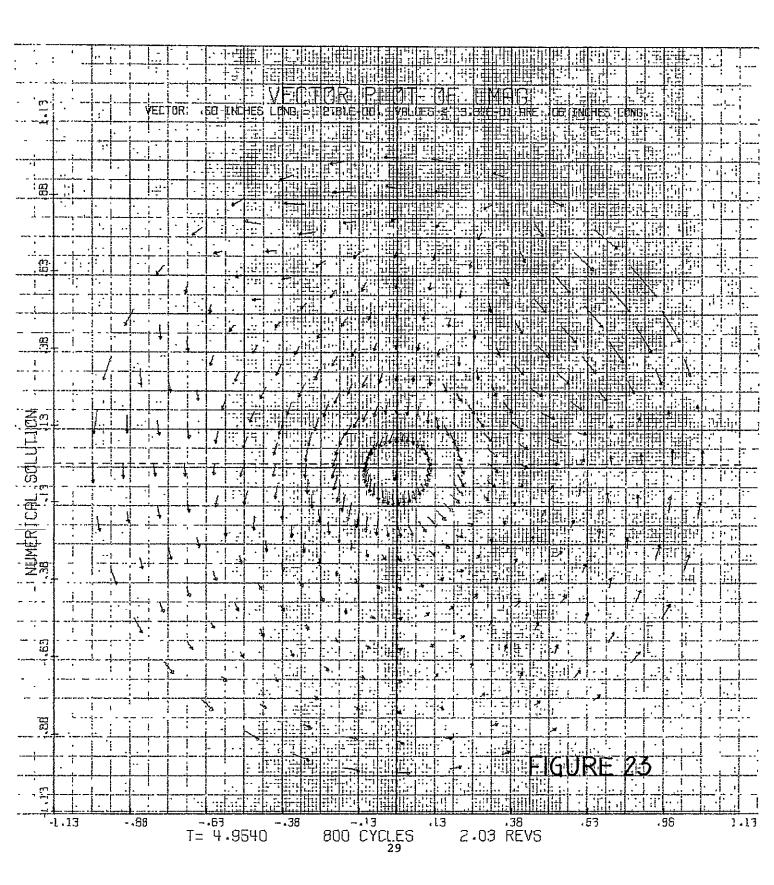
We chose  $\delta$  to be large enough so that the energy release occurred within the region of the pressure wave and nowhere else.

Finally, with the experience gained with the calculation described in section E of the second quarterly, we turn on the energy source slowly, i.e., the actual term used in the difference equation is  $\omega \dot{\mathbf{E}}$  where  $\omega$  is monitonically increasing and satisfies  $0 \le \omega \le 1$ . We take  $\omega$  to be the value of the 'rev' counter during the first rotation of the wave, it is taken as unity for all subsequent rotations.

The calculation starts off exactly as in the last section. Figures 22 and 23 show the extent of the development of the wave after about 1.8 rotations of the wave (note the velocity vector

at r=0, the rev counter, has just passed the starting position  $\theta=-\pi/2$  for the second time) and it is clear that the structure is quite similar to the non-reactive case. However, the peak pressure is 4350 psia. The velocity field is also similar to the non-reactive case. The maximum velocity in the wave corresponds to 9800 ft/sec. Of course, as the calculation proceeds, the pressure amplitude continues to grow reaching a value approximately thirty times the reference pressure while the maximum velocity reaches a value six times the reference sound speed after just four hundred more cycles of calculation.

	; ान्स्य		_		<del>(7.</del> 1		777	**7.4-	s	6-y-3-y	17.12	12112	<del></del>	(			1	1 4.		· · · ·	-1	1.1		-11	LP:		4 4-4-				<del>, , , ,</del>				
·	]	<sub>7</sub>		7.4			- 1	<u> </u>	1.1	11.1	1.1	<u>!!:</u> :	1111	a 1		団	Ē	::=	Ξ.	- <u>-</u> -	2, - 2	17-17	ĿĖ		12-1	‡#\ =	픮	4.	<u> </u>			1		- +	<b>-</b> -
	1		i				<u>  </u>	- 1	1	41	t;.;t	i } 	11:	7	7.7	11.	Ŧi_	= ::	-1.		1 1	Ē:	7‡ti	-	' '		E E		- '		; ;;	: : :	- 1	1	
	<u> </u>	;	,			} }	١. ]	: 1			<u> </u>	1:-	i : i -	7.55	F.		1	Í	<u>.</u>		٠٠.		;.i				<u> </u>	-	.	-		-		- 1	
			-				-	.11	j ef	1:1	E.:	,	· .:-	7	H: H	L.E.	F		11.		3 - 1			41.1	ÌΠ	-	1	::::	===			: 1	- 1		
			•		· .			: 1	1-7	111	<u> </u>	, i ,	·		2.,	ai.	Ē,	=-	i :			ΗĿ	711		ij	Į, r	<u> </u>	:		1					1,
	<del> </del>			-:	11:	<u> </u>	1 77.	1		1 1		ijΞ		1		<u> </u>		1		-	12	荘	- 17	1==1	#		ETP.		111				:- †		
	-		:	· · ·		<u> </u>		111	-+F			41:1	, 77		11.		II.	1+1-			-			I			35 .11:	:		.1 L C					
	<del> -</del>		<del>,-</del>	ļ				-	<del> </del>	1	H	7	-=	₿	<b>Б</b> ;∈							#	111		拱		-1		; =4	1					
	1 - zeidz - ce		, .	<u></u> _		<b>!</b>	1.	-1.	F		<u> </u>	۱۱ درن	: ;	1	N.L.	14	7.	<u> </u>	4	:41	7,4.	世	HT.	Ξ.		: <del>-</del> :-	15	11.		===	L L	<u>. II</u>	<u>.        </u>	بــٰ	·
- <del></del>	ļ		,	 		]			1:::	1 1		.11	: <del>  </del>		j. :		E.	=	; <u>-</u> <u>-</u> <u>-</u>	3	_1		1 =		苺	<u> </u>	뱊		Ī,	==		臣			
	<u>.</u>			<u> </u>					:1:	# ·		ij.; 1;	-		1		1	///	777		.:1	1	15;	1,	昆	14.4	۲.	- <del>- ; {</del>	莊			î,	İ	از	
	-		٠,	1	:	./	Ø			ļ: ;	i	:+5	ر ز	۲.	;		湛	177	141	1117	77	匪	<del> </del>	1	iirc		٠.إ		£ 7	1 1:2.		. 17	-		7
!	T-:-				7	1	7).~		ļ. ;	į. ·	1.7	11,	ij.:		1	1		7.	111	111	(;	煃			111	7	F F3			7,2					
i ,			; 	<b> </b> -	1.	<del> </del>	<b>j</b> :		!- :	<del>j.</del>	1	11/	ſ	<b>.</b>		ţ	1-1	h	10	怯	1913	加			T.E.		- <u>'</u>		H		de	R. 41	+1-1	VI.	Ö
	<u> </u>			-~	1	17	1		1212	1	<del>' ' '</del>	7		-	1.	D.	丰		卌	111	H			14 L	<u>;</u>	ij.	:	늎			-7	41.	11 CF	E=0 E+0	ļļi
	·			-		<del>/_</del>			117.	1.		1-1-	-		-	-	1		H	$\mathbb{H}$	$\vdash$	4				1		, , , L	U F			701	100	C.FU(	
		_:_	/	-را		<u>.</u>	<u></u>	<u> </u>	† ··	.:	14	<u>-`</u>	<del> -</del> -	<del> </del>	1:-	<del> </del>	1	- -	14	1		3			进	1	- 1		<u>.</u> -	7-	- ∂.	125	120 10	파카니 루브레	
	; 		سريا		<del> </del>	ļ	-			<u> </u>	1.	١.,	<u> </u>	7-1	<u>                                     </u>	<u> </u>	1	1	77	3	$\geq$						11		#:	31	-	FH.	18:	z+u. F≄fi	3.1
, <u>S</u>	<u>i</u>	/	: :	} !		<u> </u>		-	<u> </u>	<u>F</u>	11: 5	بازا	¥			<u>}                                    </u>	(-	\	$\mathcal{J}_{\mathcal{I}}$			1	-		-0	1:1:	- ! :	·;-:		===	4.	36	319	E#00 E#00 E#00	Ž
: 🗒 ;	₹-050E-07	1.	-		<b>'</b> : .		}			1,	l' ;::			Œ.	1	I.	+	F	-						Ĥ		1		4:	::=	-5	09	353	E.+O	ם_
	1	],	i 						1	<u></u>	ių:	[:]	Ŋį:	• •	14,		7:7	1.5	۱.	سنز		17		:::11	Щ		11.1	:::-	Χ-:	1-1:	5	81	386	E+0	ַן:
SØEL		,	  -		İ	<u> </u>		١.,	1:	ij,	1	17:	À		1.5	100	7	V		1	,. <u>.</u>		+ 1	11-	垣		71 H	耳	Ζ.,		- <u>6</u>	54	20	評印	1
	<del></del>		<del> </del>	午	-	-	·	÷	-	1	=	7::			-Ţ-		3		Ø -	<u> </u>		4	Щ	41.5	-1	75 ;	1, 1,	<b>‡</b> :	Ž.	377	7.	26	35.5t	£÷0	<del>]</del>
		ļ	<del>:</del>			<del> </del>	-			1::	<del> </del>		1	-	-11		Υ.	سنا	1.	<u> </u>			<u> </u>					1	ж ж	7 77	. 7 8	취임	18/	6 FL	≓
<u></u>	4-666€-01	<b>}</b>		ļ	<del></del> -	ļ	<u>.                                    </u>		<del> </del>	-	-	-	1:		1. 1	<del> </del> -		12.		ļ		<del> </del>	1.				1	11	大 文:	711	- 0	721	2211 1211	<u>; +u(</u>	<del></del>
· 🗓	,, ,	٠.٠	i	Ļ	<del> </del>	J	<del> </del>	<u>-</u>	<u>:</u>	1:	<u>  i÷</u>	1111	<u> :</u> -			1:		<u> </u>	<u> </u>			=-			17	•					j. 5	01.	2091	-TU! F#D	<u>-</u>
≦.		1	<u>:</u> _	ļ	ــــــ	<u>!</u>	<u> </u>	] -   : : : :	<u> </u>	<u> </u>		-1:	<u> </u>			1 12:	: 01		-		<u> </u>	<u> </u>	<u> </u>	<u> </u>	-7-		1 - 4		<b>X</b>	-	i : 	00	362	Ē=U	<del>], .</del>
Z	<u> </u>	}	į	<u> </u>	ن جهمرجان	<u>L</u>	ļ	<u> </u> :	<u>i. ·</u>	1:	<u> : '</u>			<u> </u> _	1.5	<u> </u>		<u> </u>	ال	<u> </u> :	· .	.: <u>:</u> ::::	1		7	115	1. !		- : : 	; E	7	16	215	E+C	
	, 		ŀΖ.		: :	<u> </u>	<u> </u>	<u>                                     </u>	<u>!:i_</u>		Ĺ	<u>_</u>	<u>: ·  </u>				<u>.</u> F.	<u>l .</u>	<u> </u>	<u> </u>	-	-11	Ŀ.		<del></del>			11.	<u> </u>		1	23		<u>:</u>	<u>i</u> ]
		-	Ż			,	ļ		1.	: :	``	: `	١. :	ļ	<u> </u>	ļ: `	= =	1.	١.			Ŀ	<u>;</u> ,.,	1		:	. !	•=;	1		1			£+()	j
	8-3006-31			1	77 77	•	;	]	1	:	ļ :		1- :	[ ]		-		Ţ	:	بزا	ستبيد		1		îl:	<del>1</del>	i	:	<u>†</u>	Ì	1	37	37 <b>6</b>	<u> </u>	1:
	;		1	<u></u> -	١٨ -	T	<u> </u>	-	1 :	.1		٠,	1		Ī		·i.				:	-7		i. , '						- : <sub>1".</sub>	11	45	153	<u>∓</u> ∓[]	1 1
	,			<u> </u>	.`	乀.	-	[ [:			†		<del>                                     </del>	<del>[</del>		-		Ī.,	-	†:	<del> </del>		Ī		٠		į. Į.			•	777	·	- 1	, <del>r</del>	
	÷	ļ		<u></u>	<del>: .</del> .	ļ	<del>\</del> -	<del>-</del>	<del>                                     </del>	: : :	<del>  ;   '  </del>	<del> </del>	<u> -</u>	<del> </del> -	ᢚ.	<del>  .</del>		<del>  • •</del>	<del>i</del> –	<del>  :</del>	<u>                                    </u>	<del>                                     </del>	<del> </del>	- :	-		• •			=	<u> </u>		-/ <u>-</u>	نبت	المالية المالية
		<del>-</del> -	·		<del>.</del>	<u>-</u>		:	<u></u>	<del></del>		ļ-:-	ļ:	ļ	+	<u>-</u>	<del> </del>		بہ ہا	i											<u></u>				
	1 1-960€+0€	<u>.</u>	! <del> </del>			<del> </del>	<del></del>	,		1=	<u> </u>	; <del></del>	<u> :</u>	<u> </u>		<u></u> :	<u> </u>	-	ļ	<del> </del>	i 	<u></u>		-::	· :	<u>  - ; ; ;  </u>	:::			<u></u> :				أجرا	
	-!- + -:		E•09	<u> </u>	<u>;</u> ;	ار ح	يق عل		<u>                                      </u>	1 3 24	! <del>ÌE`</del> ∙1	<u> </u>	<u> :</u>	Į,	die i	<b>L</b>		1, P	{u=-	<u></u>		1 : =	<u>                                     </u>			000	5~dd	`					. [	ΞÙ.	
		<u>.</u>	<u>.                                    </u>		T=	14	95	<u> 140</u>	:	. :	<u> </u>	<u>B0</u>	<u>0</u>	CY	CL.	<u> </u>		1::	2.	<u>0</u> 3	- R	ΕV	5_		-	·						<u>.</u>			· .
	1	į	•		7		[]:	:	ļ "f,	ή. 17 Ε	<u>.</u> .	  - ^ <del> </del> :			-	-	- <u> -</u>	<u> </u>	i	i				rr.			•			-	1	<u>.</u> .i		-	1 أ_ئ
			1 .	1	: :	-	į:	1		1			1:	Г. :.		ļ. 	.=:		1.	-:	; ·	[. :	·	·. ·	: ;;	<u> </u>			:.:					,,,	
	<del>1  </del>		<del>  -</del> -	1		ļ.	ļ		1	, ,	Li	E		1		1			-	1			]					``				- 1		,	•
		-:-	!	†	<del> </del>	1.	╁	= :	-:-	<u> </u>	71.		G	T	R	<u> </u>	9	7	-			<del> </del>	ļ	F .		- : [	11.1							;	f
-	<del>                                     </del>	1:-	<u>i                                     </u>	<del> </del>	<u> </u>	<del> </del>	<del>! -</del>	T -	111		<del>[ ]</del>	EH		<u> </u>	1		<u>Z</u> .	<u> </u>	1111			-		#-	- 4	1	-	: :		,; ;;;		<del> </del>		1	<u>;</u>
ļ,	-  -	ļ			1	-	-		ļ: · :		1		<del>  -</del>	ļ <u>.                                    </u>		1			<u> </u>			<u> </u>	<u> </u>		===	1:-:	11:		<u></u> .	#		<del></del> -	-		1 1 1
	<u> </u>		<u>'</u>		ļ. !.	<u>:</u> .	1	٠,:	<u> </u>	T.:	l: l: l		1.1:	1	1.1	1.+6	E	1=	(· )	Γ,,	÷;	[ :: <u>!</u>	HT"		1.:	:::1	-	:,		<u> </u>		::	- !	<u></u>	



# C. Energy Release in a Fluid with Finite Amplitude Waves (Including the Axial Flux Calculation)

It is clear from the last section that unless energy is allowed to leave the system convectively, the pressure (as well as the specific internal energy) will continue to increase monotonically. Program COMB was then modified to include, in an approximate way, a value for the axial flux of energy.

Several approximations were tried. The first method, and perhaps the most obvious, involved in essentially finding the total energy (and mass) contained in the  $r-\theta$  plane for each cycle of computation. The excess due to accumulation is parceled equally so that at each mesh point there exists a contribution to outflow which will exceed the inflow by just the amount that is accumulated. It was found that this procedure seems to work for small amplitude waves where only slight spatial variations in the energy release exist. However, for finite amplitude waves which initiate locally large influxes of mass and energy (due to increased transport processes on the droplet spray) this procedure fails to work. Some regions of the flow field where little reaction occurs see, according to this procedure, a relatively large outflow of energy (or mass). If this occurs for a sufficient number of time steps, the flow pressure (or density) can become negative locally and indeed this has been our observation. It is clear that a weighting of the outflow according to the inflow would be more desirable.

This was done for the simple energy release model given in the last section; the results being given below. The energy that was input due to combustion was allowed to reside in the r,  $\theta$ 

plane for one time step and then it was immediately considered to contribute to the axial flux. The following table gives a quick comparison of the value of  $p_{\text{max}}/\gamma p_{\infty}$  of three calculations. The first column is an inert calculation with no energy term, the second with the simple energy model including an energy flux in the axial direction, and finally the third calculation is with the simple energy model but no convective flux in the z direction, i.e., the energy is locked in.

Wave Amplitude  $(P_{max}/\gamma P_{m})$ 

Cycle	Inert Case	With Axial Flux	Trapped Case
0	1.63	1.63	1.63
600	3.25	3.73	7.18
1000	3.21	3.53	19.57
1200	3.05	3.45	29.65
1400	2.84	3,91	

The final row of data corresponds to approximately 3.27 rotations of the wave and it is clear that by including the axial flux, the rapid growth of the wave is controlled while the energy source itself supplies energy to the wave.

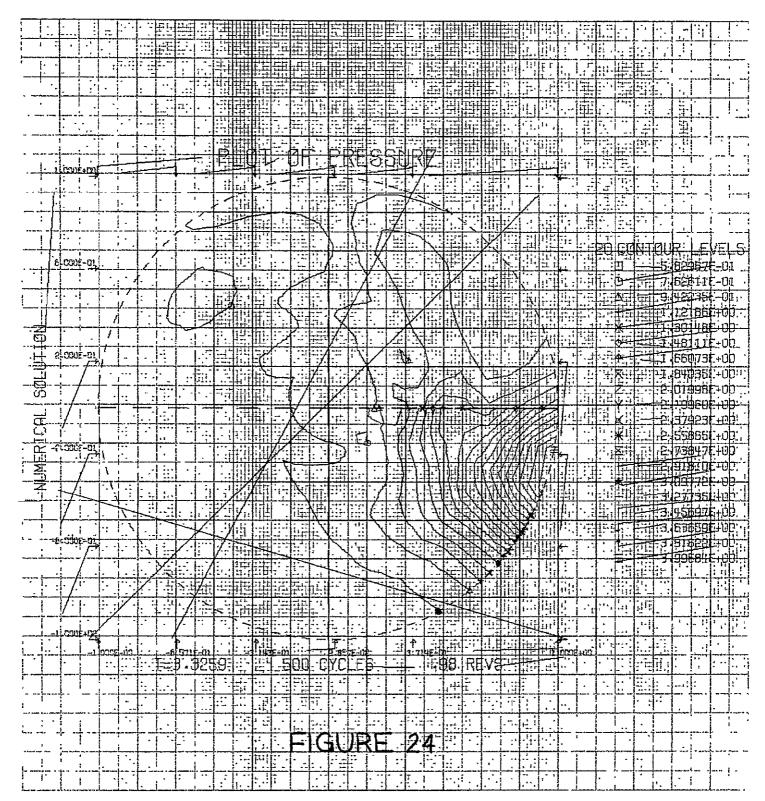
It was found that for values of ten times the constant in the energy law in section B, the solution could not be continued beyond 300 cycles. This value is consistent with a physically real energy release near the injector. It is clear that the evaluation of the axial flux is quite critical and indeed, the problem really requires a third dimension so as to mathematically pose the calculation correctly.

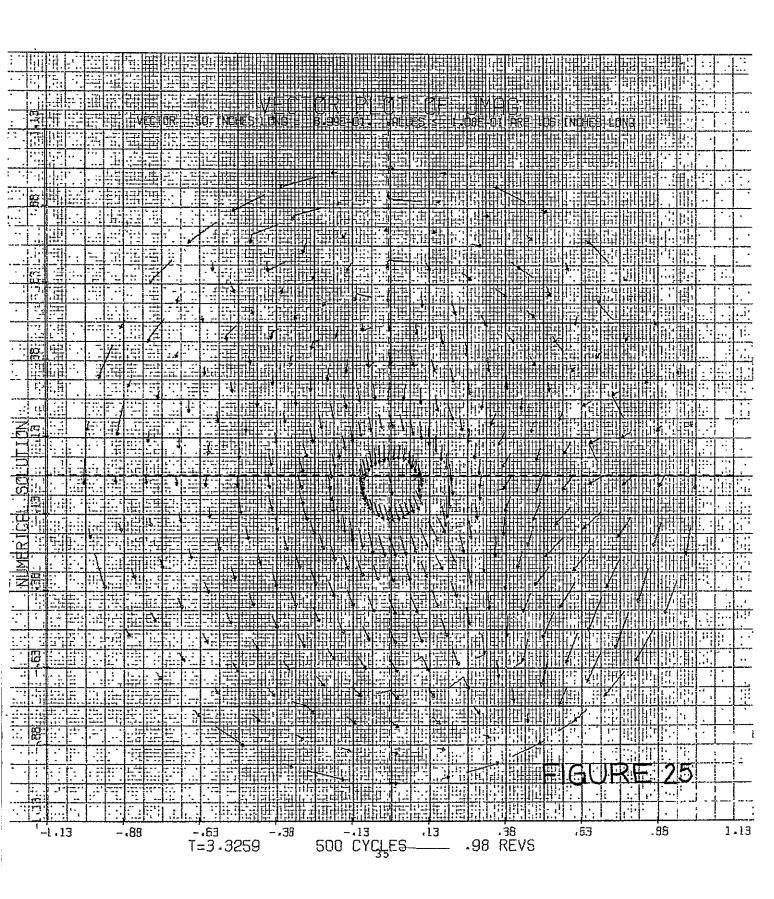
# D. Finite Amplitude Waves and Simplified Modified Godsave Analysis

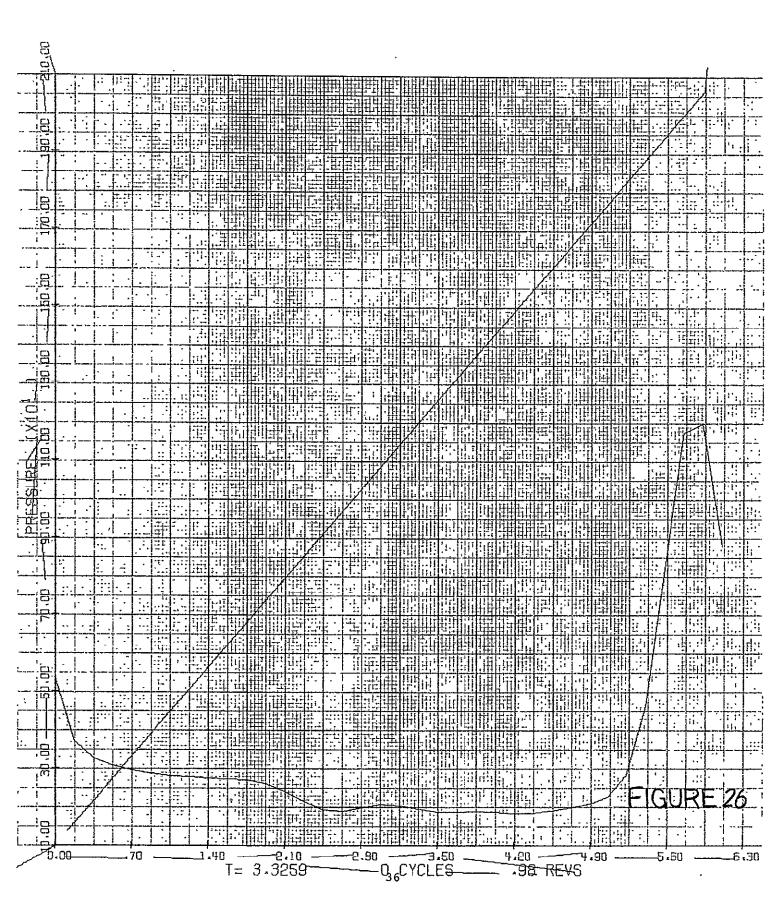
In this section we show the results of a tangential pressure wave interacting with a system of droplets (mean diameter =  $75_{\mu}$ ) which evaporates and burns according to the simplified Godsave analysis presented in Section II of this report. Hence, there is both an energy source for the energy equation as well as a mass source included in the continuity equation. However, there is no axial flux calculation included in this section.

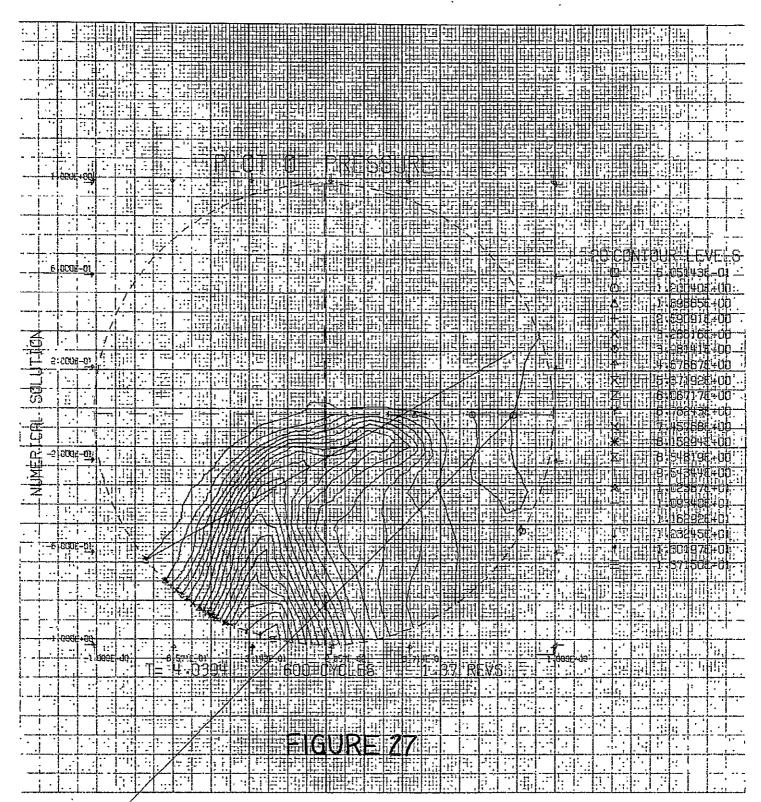
The calculation consisted in specifying the flow field at t = 0. It is similiar to that given in figures 1 and 2 except that the maximum (minimum) pressure is 550 psia (50 psia). The calculation proceeds without energy addition for as long as it takes the wave to make one complete rotation. Then the calculation incorporates the relations developed in Section II of this report for the evaporation and combustion of the droplets. The energy and mass source is turned on completely just as the wave is starting its second period of rotation. Figures 24 and 25 give the fluid dynamic field just before the droplets start interacting (excuse the extraneous hash for this series of pictures which is due to a malfunctioning solenoid valve hooked onto the pen on the Calcomp Plotter). For this series of pictures the pressure is normalized with  $p_{\infty}$  (rather than  $\gamma p_{\infty}$  as before). Figure 26 gives the dimensional pressure  $p(R,\theta)$  at t = 3.3259 units at the outer wall of the chamber (r = R), again just before the energy is switched on. The wave is moving from right to left.

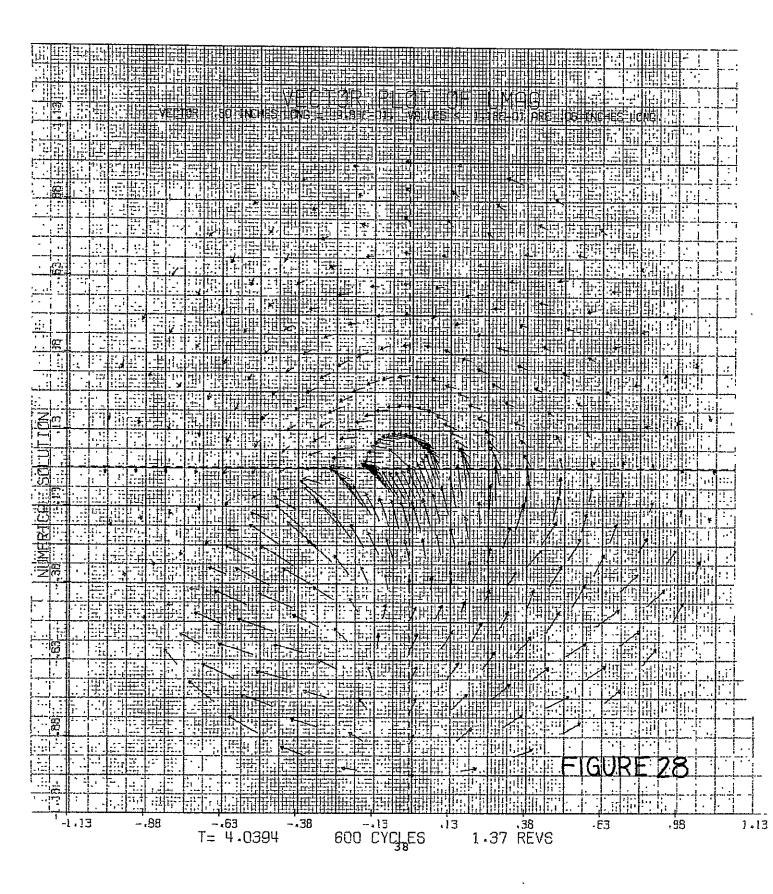
The next two figures, 27 and 28, show the initial transient as the energy is switched on. Due to large radial components, figure 28, the pressure pulse moves inward, but still undergoing rotation as the next four figures indicate (figures 29-32). The next sequence of figures (figures 33-38) show the transition to the compression/rarefaction pulse traveling along the chamber wall (except that strong radial motion flattens the pulse against the wall). This is seen from figure 39 to the final figure 44. As can be seen from figures 28 and 30, strong radial motion is generated by the large release of energy and persists as transverse motion is interacting with the tangential motion. The resultant 'steady' or time periodic pattern would require additional calculation.

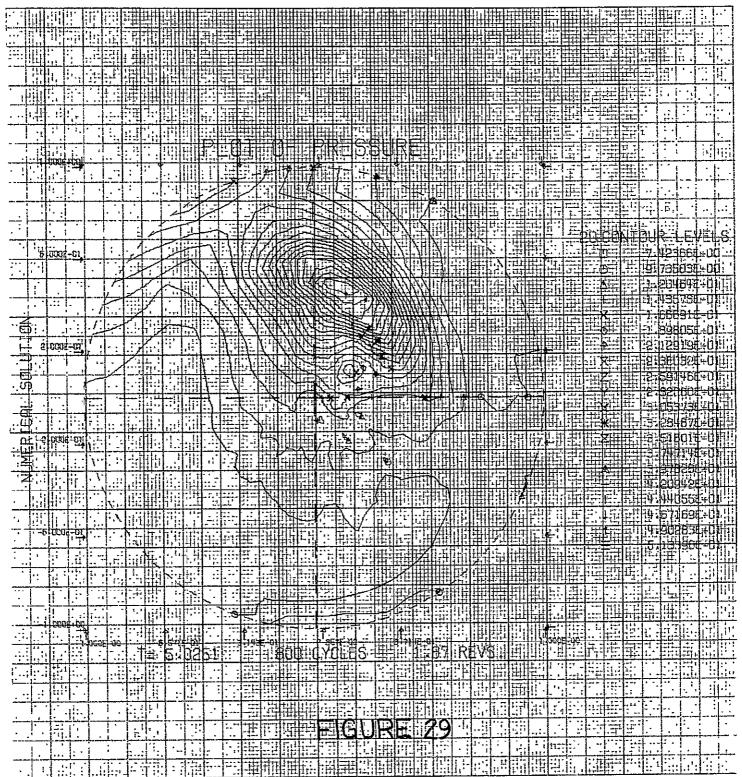


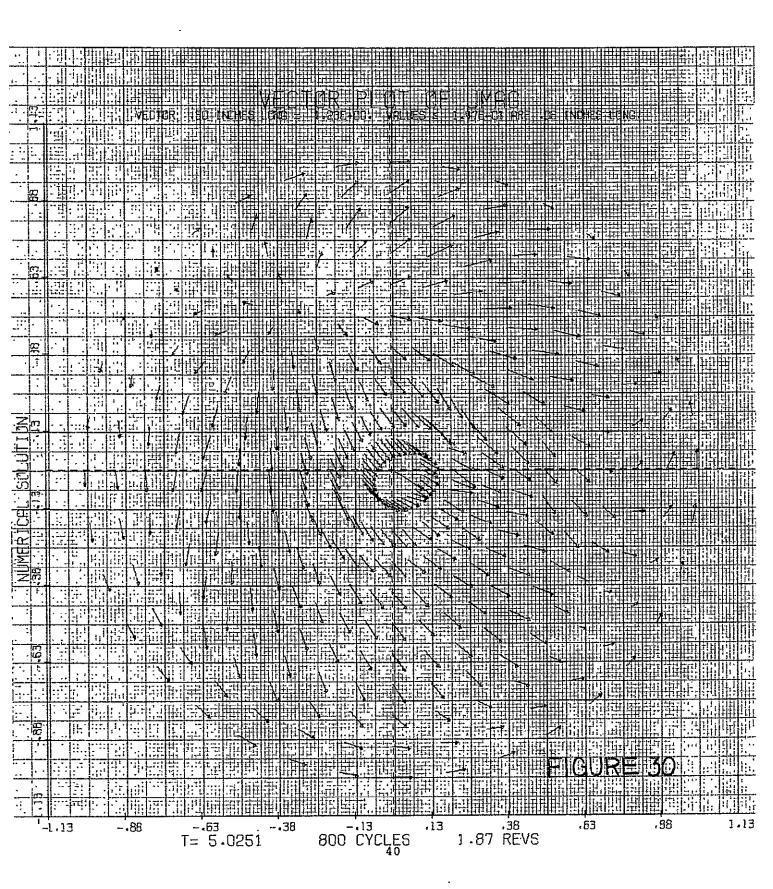


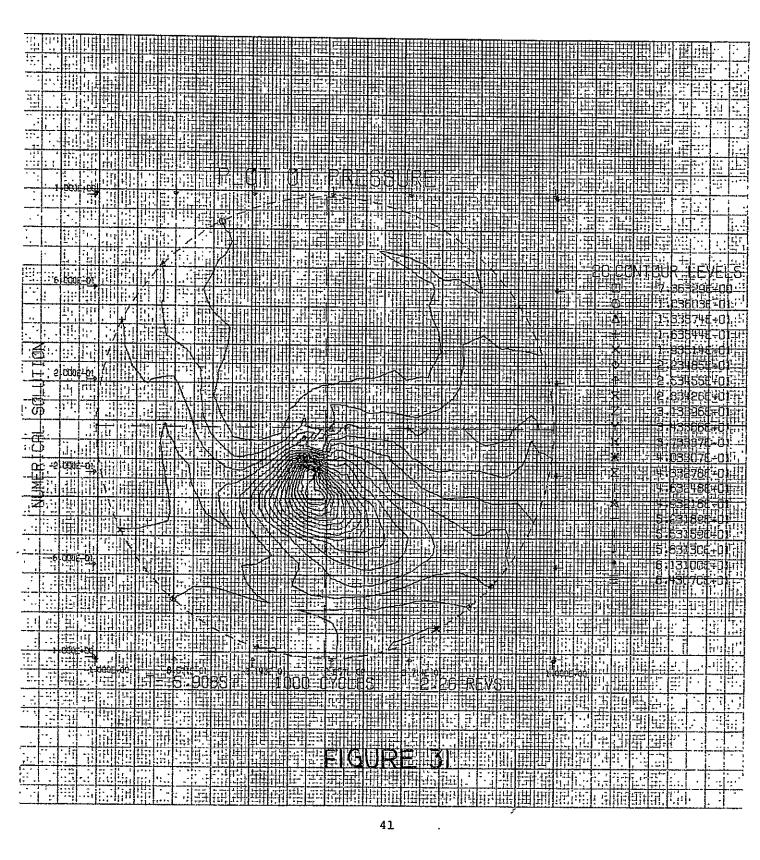


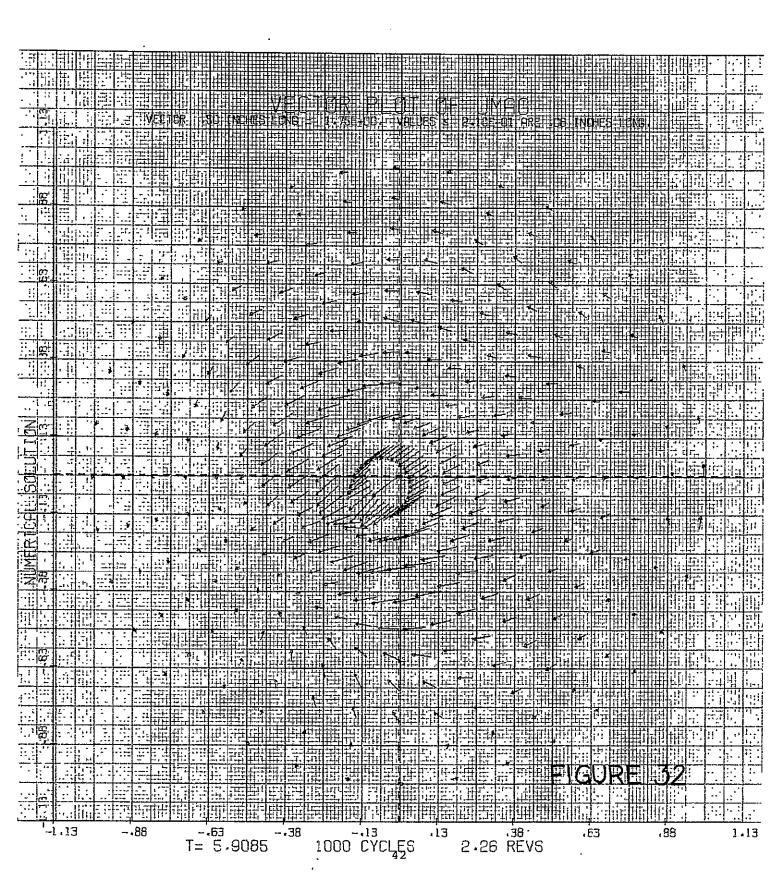


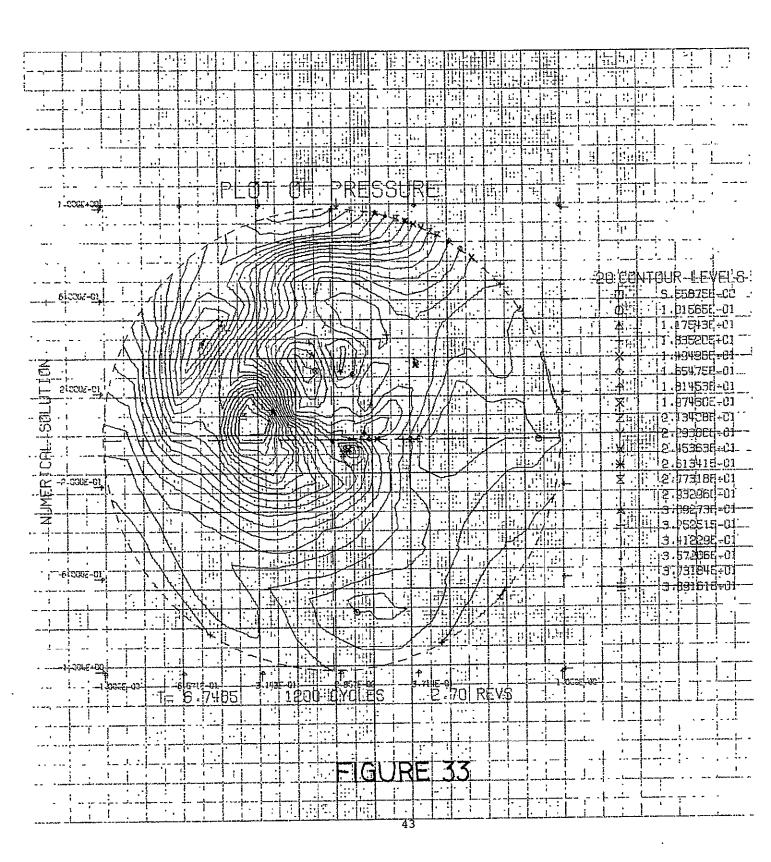


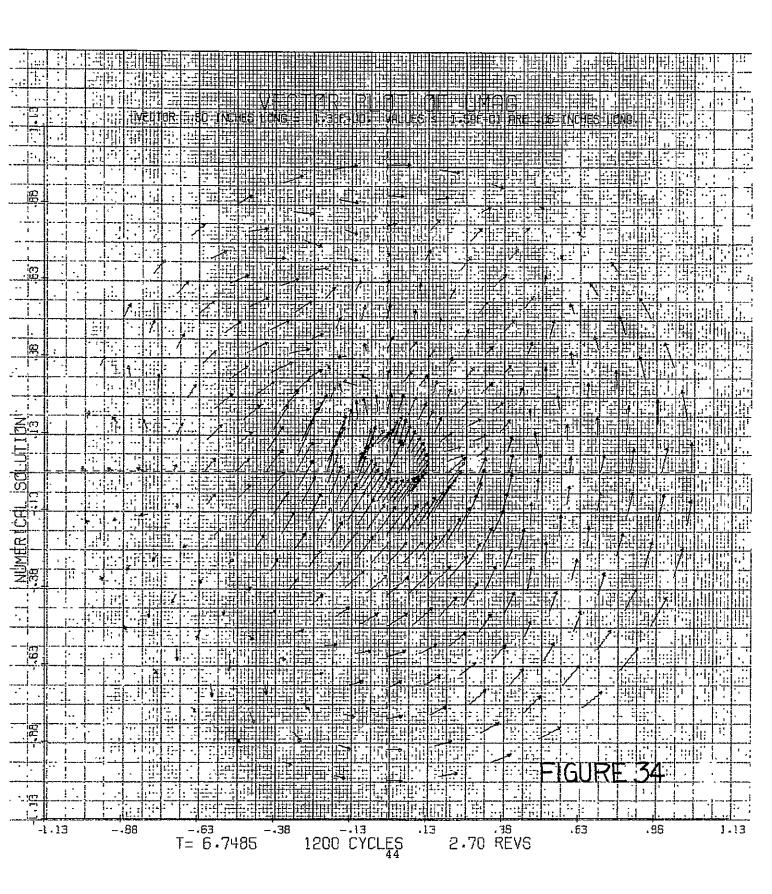


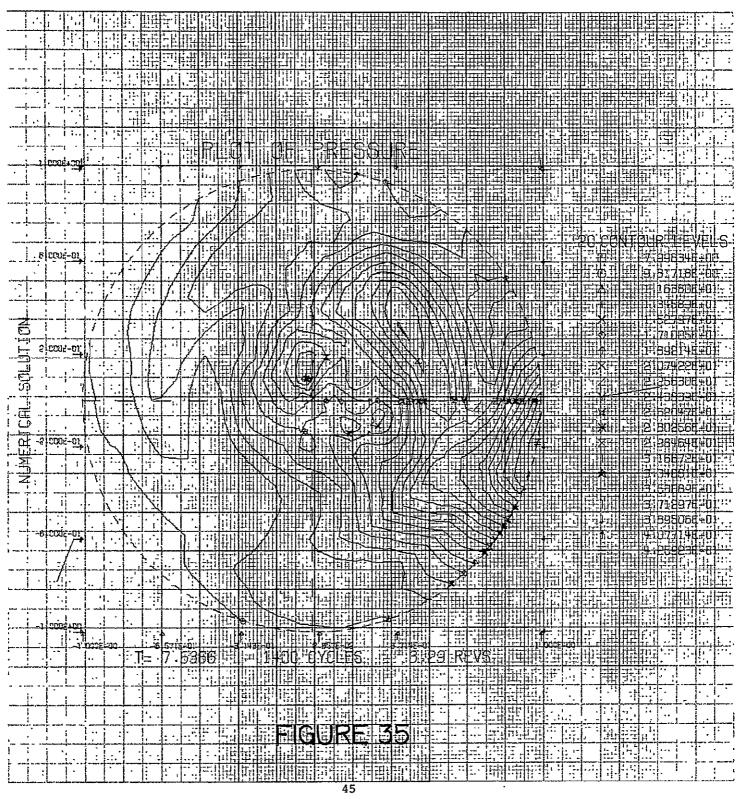


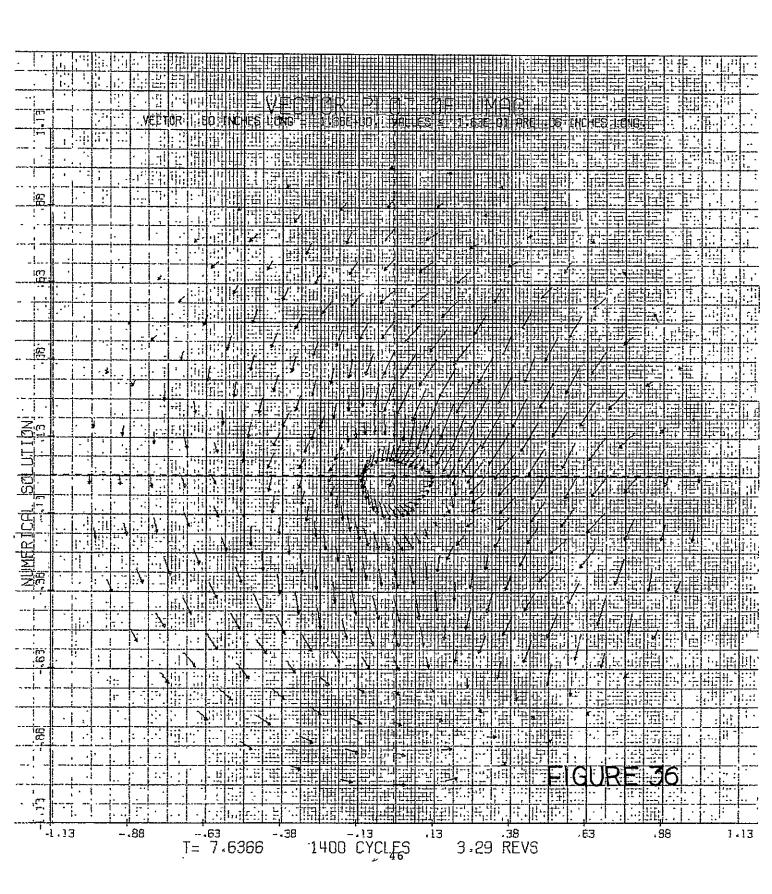


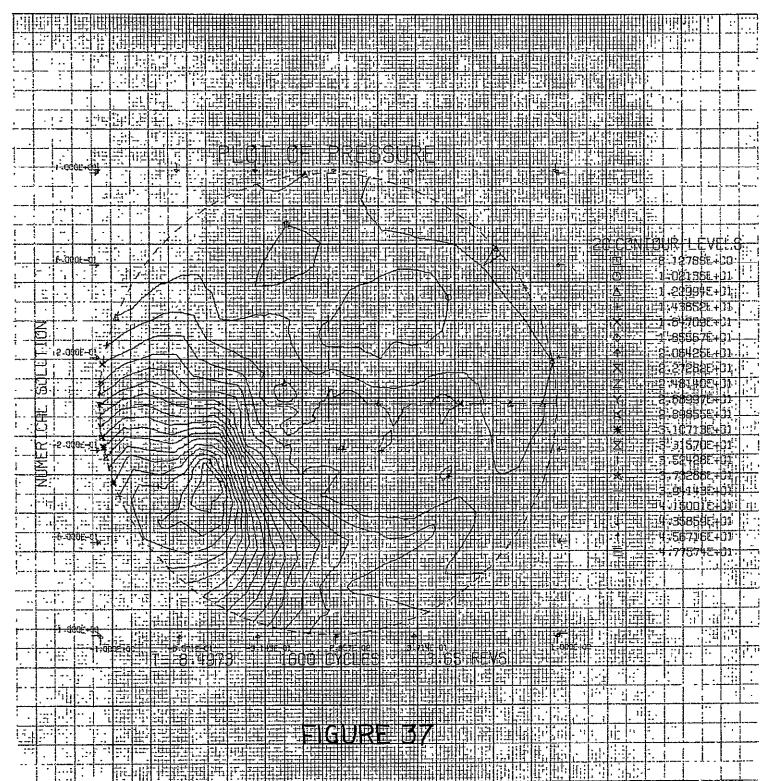


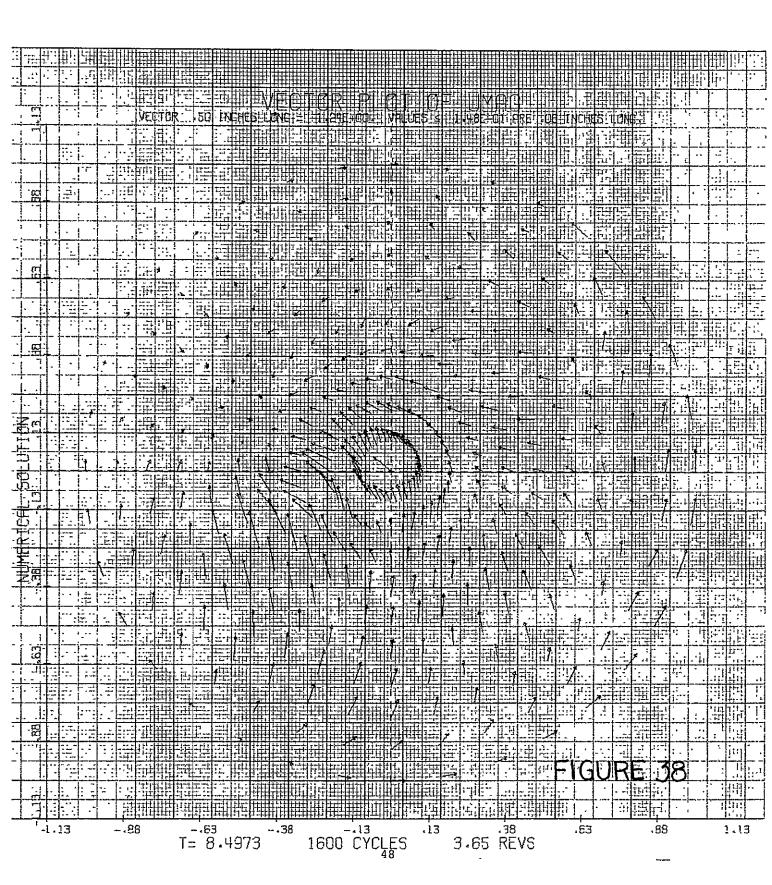


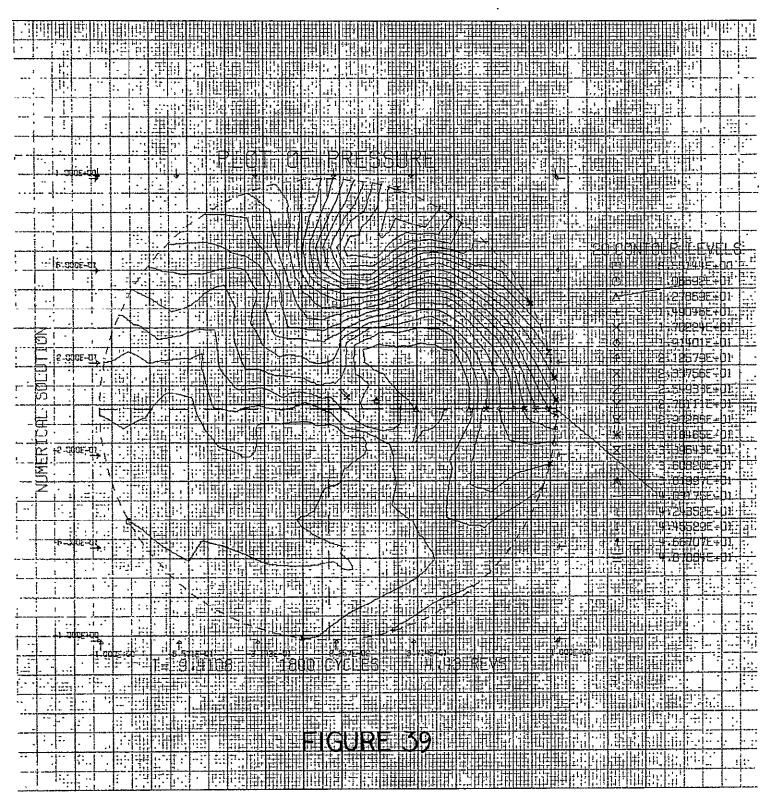


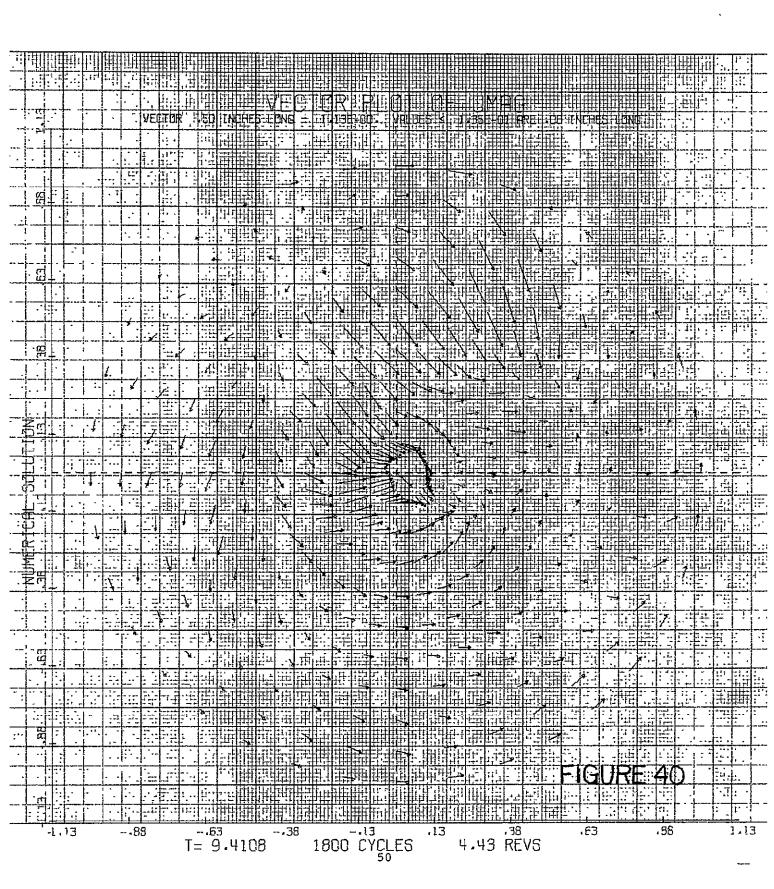


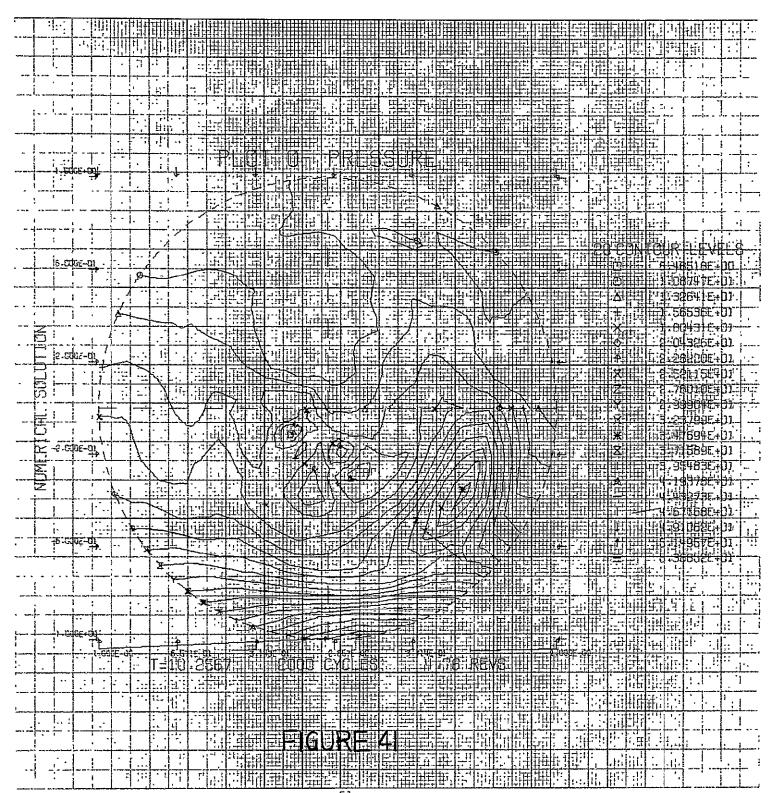


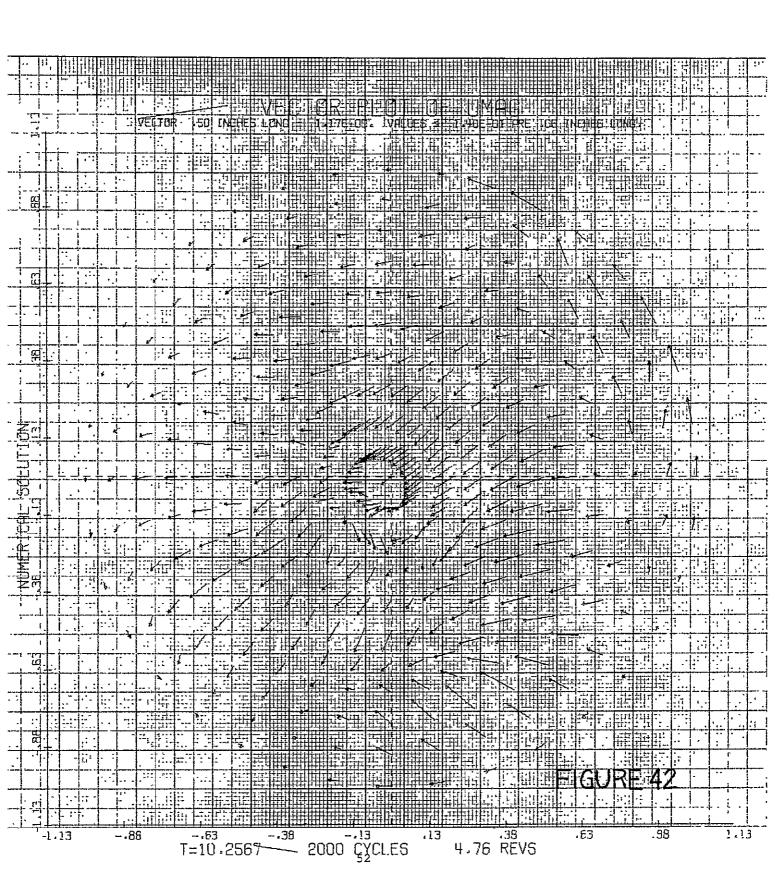


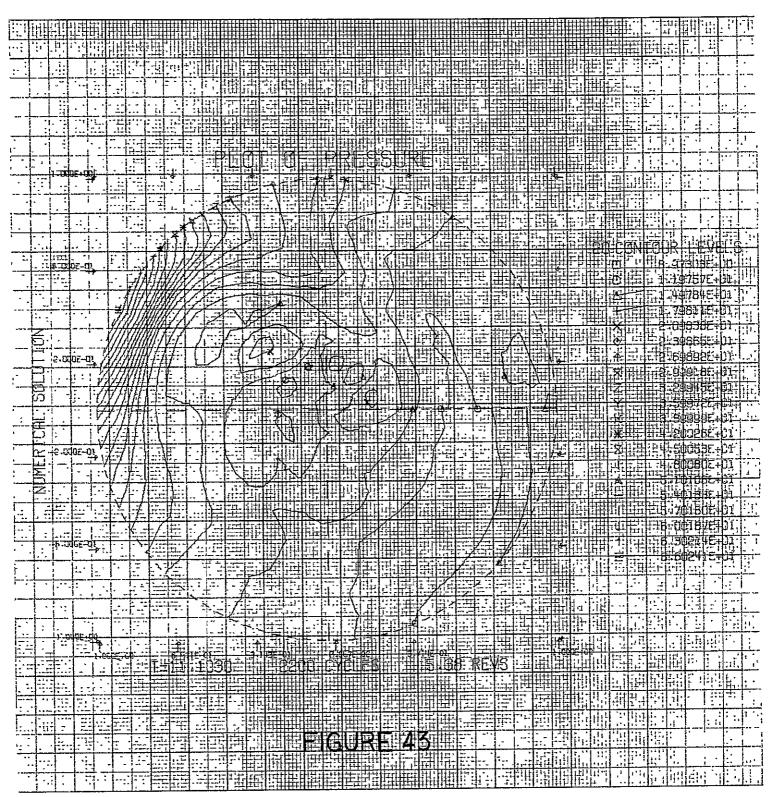


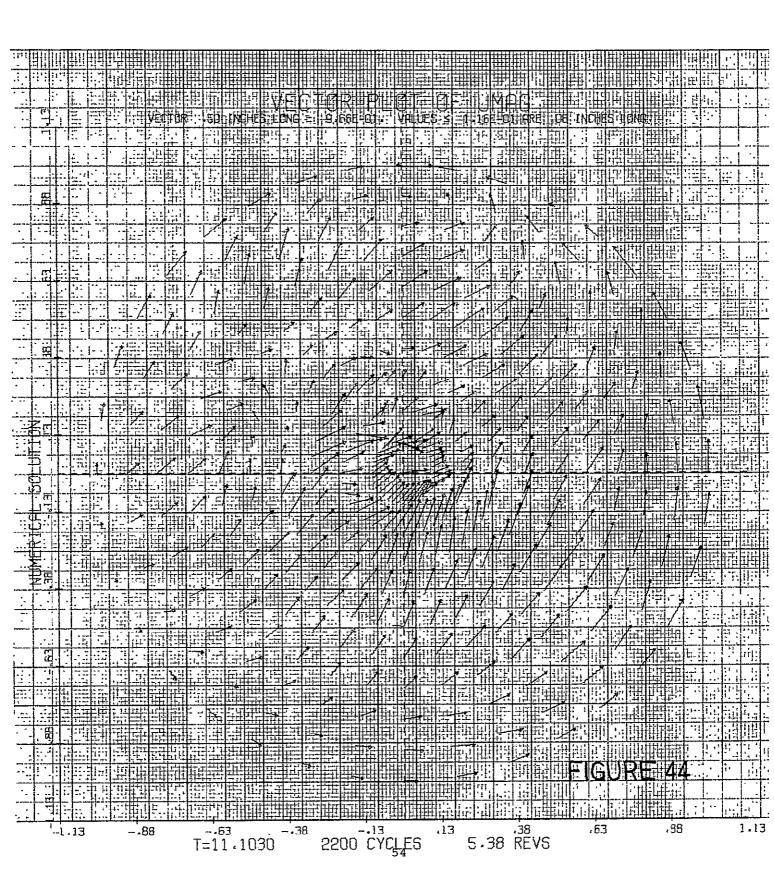












#### E. Program COMB Status

As is shown by figure 26, we have incorporated the ability to selectively plot the tangential pressure distribution at any value of radius and at any time. This feature adds flexibility to the program for ease in interpretation of the computed results.

It is anticipated that the final report will contain some instantaneous streakline pictures of 'particles' moving in the r-0 plane. The resultant motion is shown plotted as separate pictures after, say, one complete rotation of the wave. It is hoped that correlations can be made with these computed results and photographic techniques to be attempted by the JPL rocket combustion group.

The toroidal motor model is almost debugged. Tests are now being run to establish a steady state flow in the  $\theta$ -z direction with given arbitrary initial data. A simple approach has been taken so as to simulate a converging diverging nozzle. That it is necessary to incorporate a supersonic boundary condition at the outflow plane of this toroidal geometry is evident. For a liquid propellant motor the only other required boundary condition is that the normal component of velocity shall vanish on the injector face. Plotting routines have been written which will be used to see isobars and vector fields in this geometry. Some preliminary results have been obtained at this time but are too incomplete in nature to present.

### II. Droplet Evaporation and Combustion Analyses\*

## A. The Rate of the N2H4/N2O4 Reaction

It will be recalled that in order to utilize the modified flame surface analysis of Peskin and Wise (Ref. 1), some estimate is required of the overall (i.e., 'global') reaction rate constant for the  $N_2H_4/N_2O_4$  reaction (Ref. 2). That is, assuming the reaction proceeds according to

$$N_2H_4 + NO_2 \xrightarrow{k_f} \frac{3}{2}N_2 + 2H_2O$$
 (1)

some estimate of  $k_{\rm f}$  is required. (NO<sub>2</sub> is considered the oxidant rather than N<sub>2</sub>O<sub>4</sub> as a result of the high level of dissociation of the latter under most engine operating conditions.)

This estimate can be obtained from the streamtube analysis developed in Ref. 2, wherein the relevant equations and assumptions are detailed. For reference purposes, the streamtube equations are summarized here as well:

#### Energy Conservation

$$\frac{dh}{dt} = 0$$
,  $h = constant$  (2)

#### Species Conservation

$$\frac{\mathrm{d}\mathbf{Y}_{\mathbf{i}}}{\mathrm{d}\mathbf{t}} = \frac{\mathbf{r}_{\mathbf{i}}}{\rho} \tag{3}$$

#### Equation of State

$$\rho = \frac{pM}{RT} \tag{4}$$

\* Figures in this section again start with the number 1.

#### Auxiliary Equations

$$h = \int_{1}^{\Sigma} Y i h i$$
 (5)

$$M = \begin{pmatrix} \sum_{i} Y_{i} \\ \sum_{i} M_{i} \end{pmatrix} - 1 \tag{6}$$

$$h_{i} = \Delta_{i} + \bar{c}_{p_{i}} (T - T_{REF})$$
 (7)

where  $h_i$  = enthalpy (sensible plus chemical) of species i

 $r_i$  = rate of appearance (or disappearance) of species i

 $Y_i = mass fraction of species i$ 

M; = molecular weight of species i

 $\rho$  = mass density of the gas mixture

p = pressure of the mixture

T = temperature of the mixture

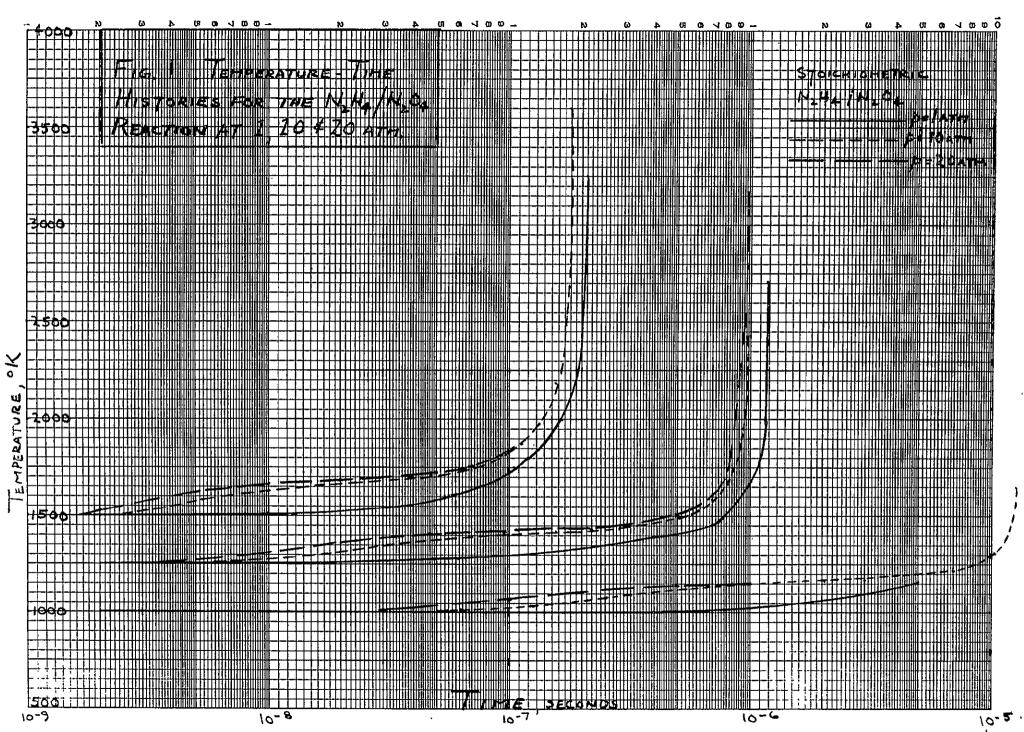
 $\Delta_i$  = reference enthalpy of species i

 $\bar{c}_{p_i}$  = average specific heat of species i

 $T_{REF}$  = reference temperature (1000°K)

t = time

Preliminary results were shown in Ref. 2. More complete results are presented in figure 1. Defining the ignition delay time ( $t_{\rm ID}$ ) qualitatively as the time required for the principal oxidation reactions to occur, figure 1 yields the anticipated result that  $t_{\rm ID}$  is a strong function of the initial mixture temperature. On the other hand, these results indicate that in the range examined,  $t_{\rm ID}$  is nearly independent of the pressure. As can be seen, at the higher pressures, the second-order reactions (which become more significant at higher pressures) produce an initial partial oxidation which results in a slight temperature increase. However, a leveling-off period is seen to subsequently



occur, followed by the <u>principal</u>, <u>first-order</u> oxidation processes which drive the reaction to completion.

As a result, the reaction may be said to be first-order, with ignition delay times (taken from figure 1) as shown in figure 2. In this latter figure,  $T_{\dot{1}}$  is the initial mixture temperature. The approximate straight line behavior of  $\ln t_{\dot{1}\dot{0}}$  when plotted against reciprocal initial temperature is in accordance with elementary chemical kinetic thoery which predicts a function of the form

$$t_{ID} = \alpha \cdot \exp (E/RT_i)$$
 (8)

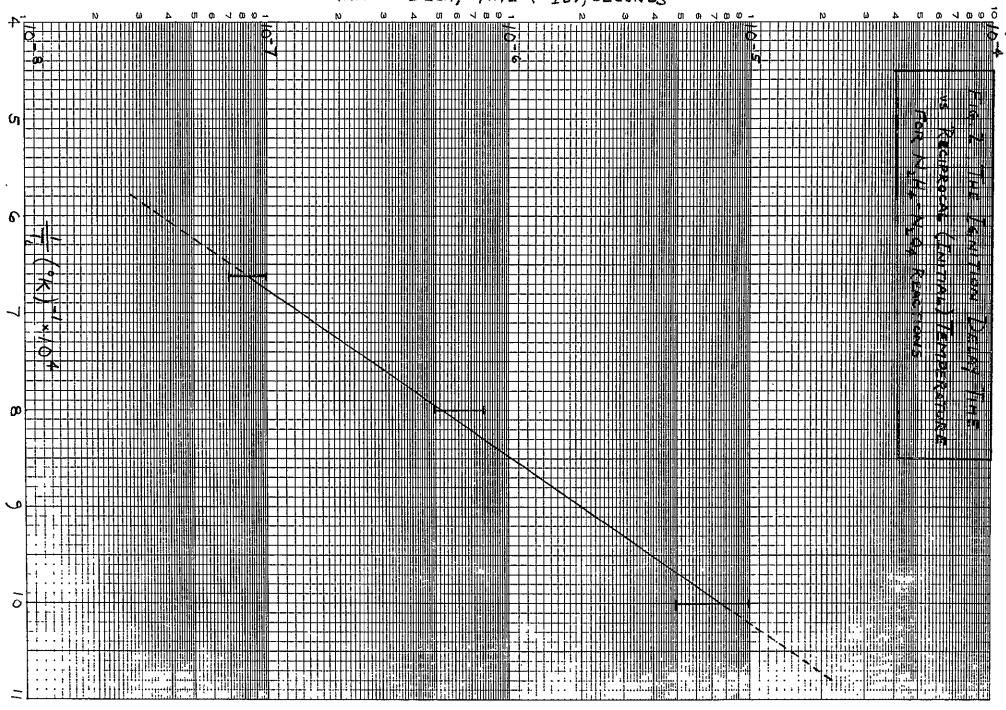
where  $\alpha$  is a constant and E is an overall activation energy. From figure 2, E was determined to be about 26,800 calories/mole.

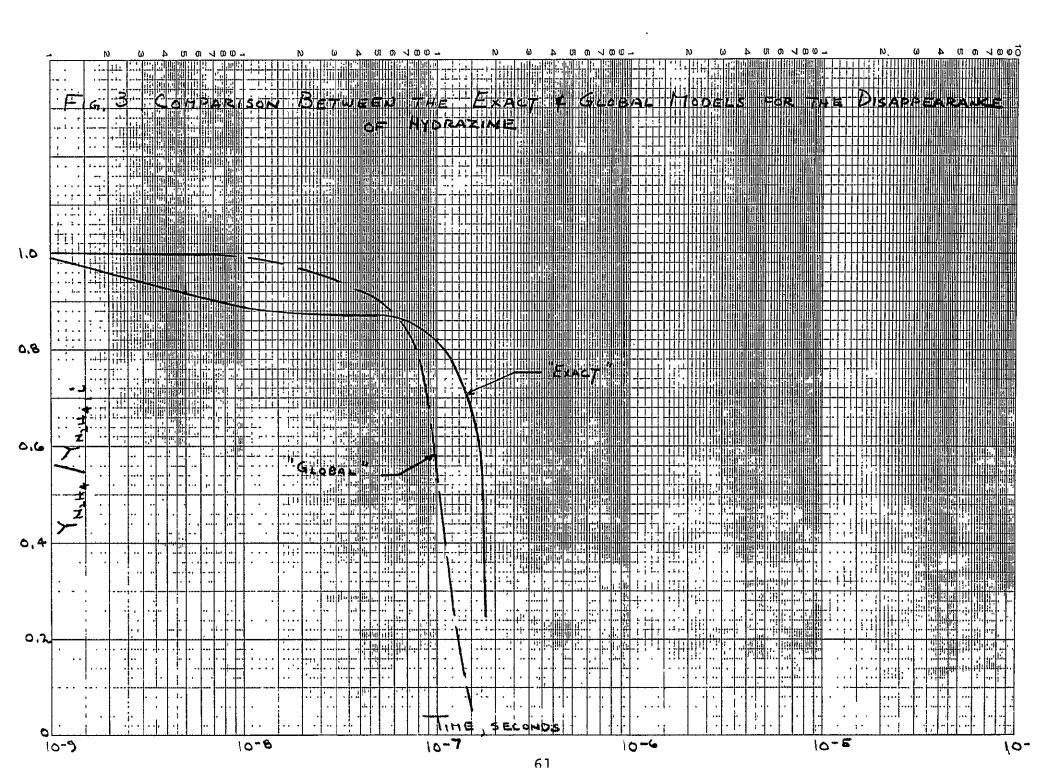
As an initial estimate, the pre-exponential factor in the overall reaction rate constant was chosen to be the average of the pre-exponential factors for the  $N_2H_4$  oxidation reactions as deduced by Sawyer (see Ref. 2, Table I). From this and the result obtained above, the initial estimate of the overall reaction rate constant was

$$k_f = 1.2 \times 10^{10} \exp (-26,800/RT)$$
 (9)

To check this estimate, results using eq. 9 were checked against results obtained using the complete streamtube analysis. The comparison was made at high pressure (20 atm), where the first-order approximation and eq. 9 would be least accurate. The results are shown in figure 3, with the streamtube result labeled 'exact'. The global model does not, of course, predict the initial reactions or the leveling off period after the initial second-order

## IGNITION DELAY TIME (tID), SECONDS





reactions have occurred, but the general behavior and the delay time appears to be reasonable. Although the result for this particular case could have been improved by adjustment of the preexponential factor in eq. 9, this was felt to be unwarranted, and eq. 9 was selected as a suitably accurate overall reaction rate constant for inclusion in the modified flame surface analysis.

#### B. The Modified Flame Surface Analysis

Under the assumptions inherent in the modified flame surface analysis, as detailed in Refs. 2 and 3, the species conservation and energy equations were shown to reduce to

$$a\frac{dY_{i}}{d\eta} - \frac{d}{d\eta} \left(\eta^{2} \frac{dY_{i}}{d\eta}\right) = -i_{i} \eta^{2}b Y_{F}^{N_{F}} Y_{O}^{N_{O}}$$
(10)

$$a\frac{dt}{d\eta} - \frac{d}{d\eta} \left( \eta^2 \frac{dt}{d\eta} \right) = \eta^2 b Y_F^{N_F} Y_0^{N_O}$$
(11)

where a = dimensionless mass burning rate =  $\dot{m}_F^O/(4\pi r_D k/c_D)$ 

m<sub>F</sub> = mass burning rate in stagnant surrounding

 $r_D$  = fuel droplet radius

k = thermal conductivity

 $\eta = \dot{r}/r_D$ 

 $i_i = v_i M_i / v_F M_F$ 

 $v_i$  = stoichiometric coefficient of species i

 $N_{\mathrm{F}}$  ,  $N_{\mathrm{O}}$  = reaction orders with respect to fuel and oxidizer

 $b = k_f r_D^2 / D$ 

D = binary diffusion coefficient

 $t = (T-T_{\infty})/(Q/c_{p})$ 

Q = heat of reaction

 $T_{\infty}$  = temperature in the ambient gas mixture

On the basis of the conclusions drawn in the previous section,  $N_{\rm O}=0$  and  $k_{\rm f}$  is given by eq. 9. When eq. 10 is written first for the fuel and then for the oxidizer, and the resulting equations subtracted, an integrable ordinary differential equation results

subject to the following boundary conditions:

$$\frac{d}{d\eta} \quad Y_0 = a \quad Y_0 = 1$$

$$\frac{d}{d\eta} \quad Y_F = a \quad Y_F = a \quad Y_F = a \quad A_F 

When eq. 10 written for the fuel is added to eq. 11, another integrable ordinary differential equation results subject to these boundary conditions:

$$\frac{dt}{d\eta} \int_{\eta \to \infty} = \frac{L}{Q} a$$

$$t \int_{\eta \to \infty} = 0$$

The resulting equations can be manipulated to yield the following expression for the dimensionless mass burning rate:

$$a = \ln \left[ \frac{1 - \frac{L}{Q} + t_s}{1 - \frac{L}{Q} - Y_{F,s}} \right]$$
(12)

where L = latent heat of vaporization of the fuel

 $t_s$  = dimensionless droplet surface temperature

 $Y_{F,S}$  = mass fraction of fuel at the droplet surface

We now introduce the additional assumption that the flame zone of finite thickness can be replaced by an infinitessimal one represented by a Driac-delta function located such that the fuel and oxidant react stoichiometrically. As a consequence, the right-hand-sides of eqs. 10 (written for the fuel) and 11 become

$$\eta^2_b Y_F^* \cdot \delta(\eta - \eta^*)$$

where the asterisks refer to the values at the hypothetical flame surface, and  $\delta$  is the delta function. (Note that the fact that  $N_O=0$  has been used in writing this term.)

Peskin (Ref. 1) shows that a solution to equation 10 with this right-hand-side is given by generalized function theory as

$$Y_{F} = \frac{b^{*}}{a} Y_{F}^{*} \eta^{*2} e^{-a/\eta} \begin{cases} 1 - e^{a/\eta} & \text{for} \eta > \eta^{*} \\ 1 - e^{a/\eta^{*}} & \text{for} \eta < \eta^{*} \end{cases} + 1 - e^{-a/\eta}$$
(13)

Therefore, for  $\eta = \eta \, {}^{\star} \, , \ Y_F = Y_F$  and eq. 13 becomes

$$Y_{F}^{*} = \frac{(1-e^{-a/\eta^{*}})}{1+\frac{b^{*}}{a}\eta^{*2}(1-e^{-a/\eta^{*}})}$$
(14)

Now when eq. 13 is solved for  $\eta=1$ ,  $Y_F=Y_{FS}$ , and eq. 14 is used, the result is

$$Y_{FS} = \frac{\frac{b^*}{a} \eta^{*2}}{1 + \frac{b^*}{a} \eta^{*2} (1 - e^{-a/\eta^*})} (1 - e^{-a/\eta^*}) + 1 - e^{-a}$$
(15)

From the difference between eq. 10 written for the fuel and the oxidizer, and using the appropriate boundary conditions, the following expression is obtained for  $n^*$ :

From the sum of equations 10 (written for the fuel) and 11, again subject to the appropriate boundary conditions, the following expression can be derived for t\*:

$$t^* = \frac{({}^{Y}FS + {}^{t}S) (e^{-a/\eta^*}-1)}{e^{-a}-1} - \frac{(1-e^{-a/\eta^*})}{1+\frac{b^*}{a} {}^{\eta^*}{}^2}$$
(17)

in which equation 14 was also used.

Finally, using the result of the previous section, b\* can be written

$$b^* = \frac{r_D^2}{D} \quad \left[ 1.2 \times 10^{10} \cdot \exp(-26,800/RT^*) \right]$$
 (18)

Equations 12, 15, 16, 17, and 18 constitute five equations in the five unknowns a,  $Y_{FS}$ ,  $n^*$ ,  $T^*$ , and  $b^*$ . (Unlike Peskin (Refs. 1, 4, 5), we are not interested here in species and temperature profiles surrounding the droplet, but in the mass burning rate a; as a consequence, the equations developed above are particularly suited to this purpose.)

Results using this analysis have been obtained for the following values of the parameters:

$$Y_O(\infty) = 0.25$$

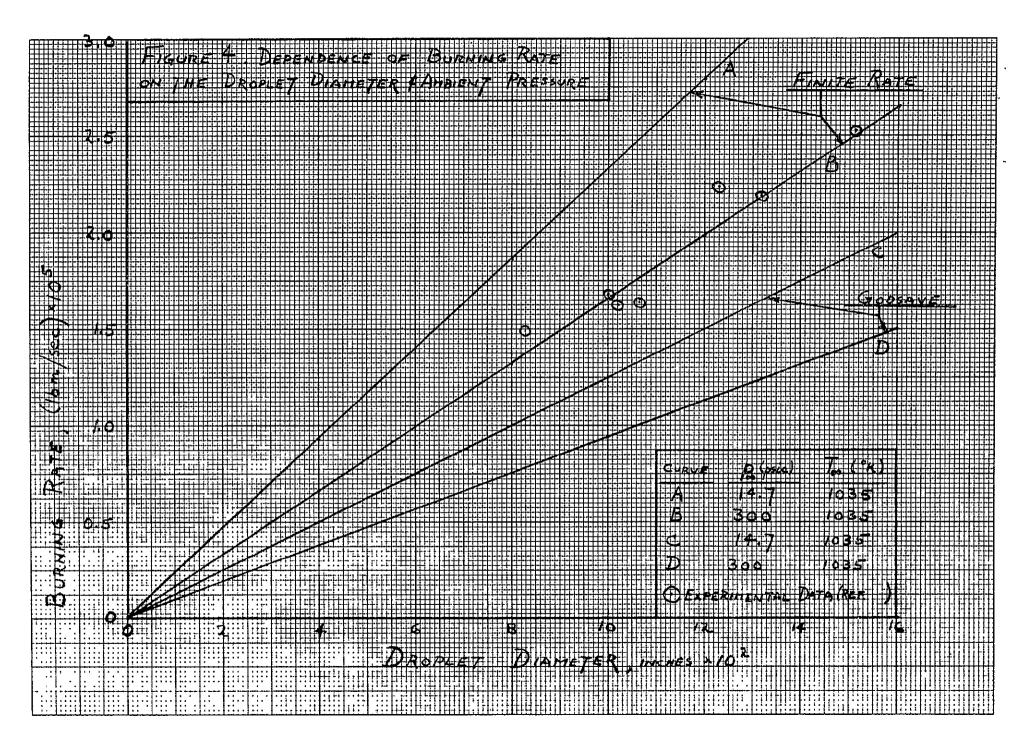
$$D = 10^{-4} \frac{ft^2}{sec}$$

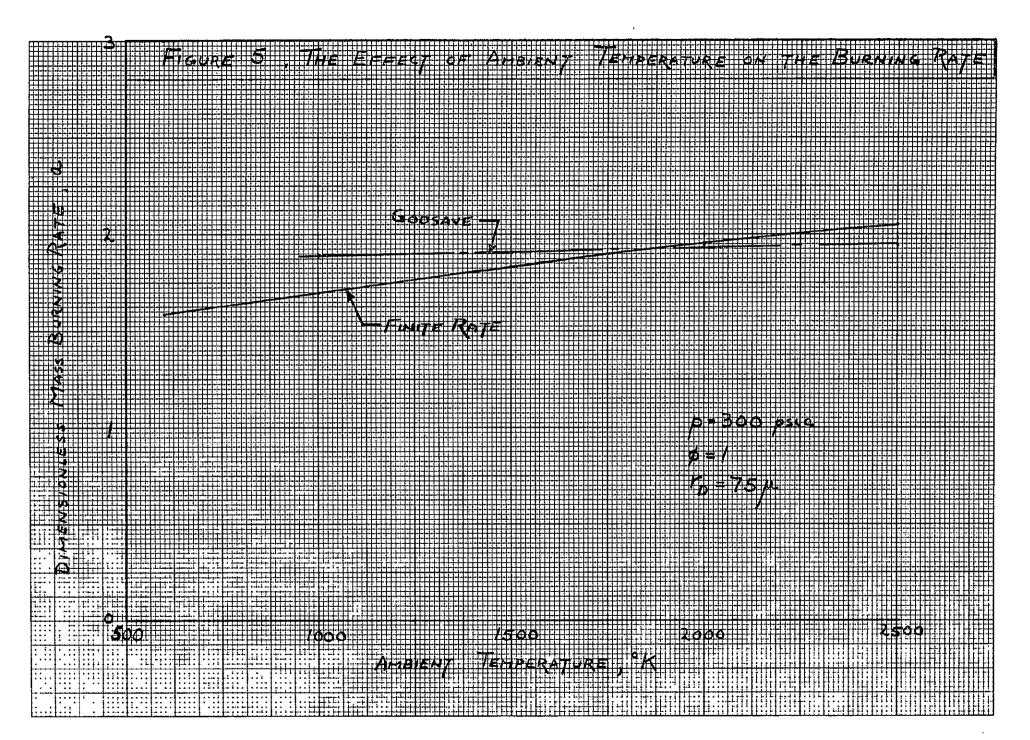
$$i_O = \frac{23}{36} \text{ (see eq. 1)}$$

Q was calculated from the enthalpies obtained from eq. 7; L was obtained from the Clausius-Clapeyron equation using the vapor pressure data in Ref. 6; in going from a to  $\mathring{\mathfrak{m}}_{F}^{O}$ , k was obtained from Ref. 6 and  $c_{p}$  from Ref. 7.

Results are shown in figures 4, 5, and 6. In figure 4, the results are compared with the previous results obtained from the Godsav analysis (Ref. 2) and the experimental results of Ref. 8. As can be seen, the current analysis yields results which are about 80% higher over most of the range of  $r_D$  than the corresponding Godsav value. This is due, at least in part, to the values chosen for  $Y_O(\infty)$  and D, as well as the differences inherent in the two approaches. It is interesting to note, however, that the line corresponding to  $T = 1035^O$ K, p = 300 psia (Curve B) passes right through the experimental points of Ref. 8. Unfortunately, Ref. 8 does not indicate the level of pressure at which these experiments were conducted, leaving this possible correlation unresolved. However, the linear dependence of the burning rate on droplet diameter is retained by the modified flame surface analysis, in accordance with the experimental results.

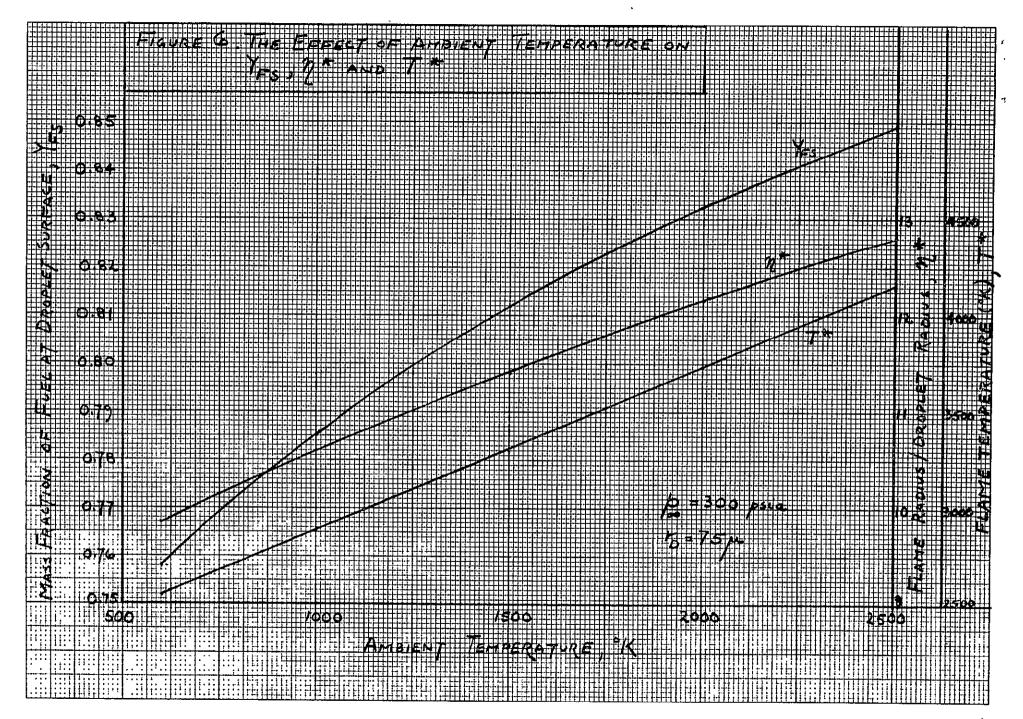
Figure 5 contrasts the ambient temperature dependence of this analysis and the Godsav analysis for the particular conditions noted. It was pointed out in Ref. 2, and can be seen in figure 5, that the Godsav analysis yields a very weak, almost linear ambient temperature dependence. Most experimental work indicates a stronger, non-linear dependence. The modified flame surface analysis does yield this latter type of dependence. It may be justifiably said, however, that the differences between the two analyses at these particular conditions are not sufficiently great to warrant using the current analysis in the fluid dynamics program. In particular, no evidence of extinction can be seen down





to ambient temperatures near the boiling point of the fuel. If this same result is discovered at other values of the ambient pressure as well, this will constitute ample justification for the use of the simpler Godsav analysis.

The effect of ambient temperature on the values of  $Y_{FS}$ ,  $\eta^*$  and  $T^*$  are shown in figure 6. The value of  $Y_{FS}$  as  $T_{\infty}$  increases, in accordance with the assumption of the Godsav, diffusion-flame approximation  $(Y_{FS=1})$ . The hypothetical flame surface moves away from the droplet as  $T_{\infty}$  increases; this stems from the fact that in order to sustain a stoichiometric combustion process, the flame location must move away from the flame surface where a larger quantity of fuel vapor  $(Y_{FS})$  is being produced. Finally,  $T^*$  exhibits a linear dependence on  $T_{\infty}$ .



### C. The Reduced Godsav Analysis

Preliminary runs which coupled the complete Godsav analysis to the fluid dynamics program indicated that the running times were excessively long. (Roughly, five times slower than with the elementary energy term previously used.) As a consequence, the results obtained to date from the Godsav analysis (Ref. 2) were used to formulate the following simplified version of this analysis:

The weak, almost linear, temperature dependence of the dimensionless mass burning rate can be approximately expressed as

$$a_{300} = (3.73 \times 10^{-5}) (T_{\infty}) + 1.855$$
 (19)

where  $a_{300}$  is the dimensionless burning rate at a chamber pressure dependence is approximately given by

$$\frac{a_{p}}{a_{300}} = \left(\frac{p_{\infty}}{300}\right)^{-0.0108} \tag{20}$$

Once  $\mathbf{a}_{\mathbf{p}}$  is computed, the burning rate in stationary surroundings is obtained from

$$\mathring{\mathbb{n}}_{F}^{Q} = \underbrace{2\pi k}_{C_{p}} \mathring{\mathbb{q}}_{L} \mathfrak{a}_{p} \tag{21}$$

where  $d_{\rm L}$  is the drop diameter, and the thermal conductivity and specific heat are functions of the liquid drop temperature.

The drop temperature,  $T_{\rm L}$ , which is the boiling temperature at the chamber pressure, can be obtained to a good approximation from the integrated Clausius-Clapeyron equation

$$\ln \frac{p}{2131} = (8.7 \times 10^3) \left( \frac{1}{1176} - \frac{1}{T_L} \right) \tag{22}$$

where p is in psia,  $T_{\rm L}$  is in  $^{\rm O}{\rm R}$ , and the critical point conditions are 2131 psia, 1176  $^{\rm O}{\rm R}$ .

Knowing  $T_{\rm L}$ , K is obtained from a linear curve fit of the data in Ref. 6:

$$\dot{K} = \frac{1}{3600} \left[ (-8.33 \times 10^{-5}) (T_L - 460) + 0.2107 \right]$$
 (23)

and  $c_p$  is obtained from Ref. 7:

$$c_p = 0.138 + 0.527 \times 10^{-3} T_L - 0.120 \times 10^{-6} T_L^2$$
 (24)

From  $\dot{m}_{F}^{O}$ , the burning rate in the convective environment is then obtained from (see Ref. 3, eq. 21):

$$\frac{\hat{\mathbf{m}}_{F}}{\hat{\mathbf{m}}_{F}} = 1 + 0.276 \text{ (Re)}^{\frac{1}{2}} \text{ (Pr)}^{\frac{1}{3}}$$
 (25)

Under the engine conditions of interest, the following constant values are reasonable:

$$Pr^{1/3} = 0.6$$

$$L_F = 540 \frac{Btu}{10m}$$

$$L_0 = 178.2 \frac{Btu}{1bm}$$

$$Q = 12,400 \frac{Btu}{lbm}$$

where  $L_F$  is the latent heat of the fuel,  $L_O$  is the latent heat of the oxidizer, and Q is the heat of reaction. The appropriate terms in the  $\psi$ -vector of the fluid dynamics program may now be obtained as shown in Ref. 3 (eq. 22). Results obtained using this approximate formulation are shown elsewhere in this report.

#### REFERENCES

- 1. Peskin, R. L. and Wise, H., AIAA Journal, 4, 1646 (1966).
- 2. Burstein, S. Z. and Chinitz, W., "Nonlinear Combustion Instability in Liquid-Propellant Rocket Motors", 2nd Quarterly Report, Mathematical Applications Group, Inc., January 30, 1968.
- 3. IBID, 1st Quarterly Report, October 30, 1967.
- 4. Peskin, R. L., et.at., AIAA Journal, 5, 2173 (1967).
- 5. Polymeropoulos, C. E. and Peskin, R. L., "Theoretical Calculations of Fuel Drop Ignition and Extinction", Paper USCI-67-5, Western States Section/The Combustion Institute, April, 1967.
- 6. Aerojet-General Corporation Report on Properties of Propellants
- 7. Haws, J. L. and Harden, D. G., J. Spacecraft and Rockets, 2, 972 (1965).
- 8. Dynamic Science Report No. SN-95-4, Monthly Progress Report under Contract No. NAS7-567, 1967.

# A Reproduced Copy of

N68-31405

Reproduced for NASA  $by \ the \\ \textbf{NASA Scientific and Technical Information Facility}$ 

NIV

### Nonlinear Combustion Instability in Liquid-Propellant Rocket Motors

Samuel Z. Burstein and Wallace Chinitz

Third Quarterly Report

to

Jet Propulsion Laboratory

-	30, 1968	
1		

GPO PRICE \$ \_\_\_\_\_

Hard copy (HC) \_\_\_\_\_\_

ff 653 July 65

Mathematical Applications Group, Inc.

180 South Broadway

White Plains, New York

	N 68-3140	)5
FORM 602	(ACCESSION NUMBER)	(THRU)
i _	(PAGESY	(CODE)
FACILITY	(NASA CR OR TMX OR AD NUMBER)	(CATEGORY)
	and the control of th	e e e e e e e e e e e e e e e e e e e

## Nonlinear Combustion Instability in Liquid-Propellant Rocket Motors

Samuel Z. Burstein and Wallace Chinitz

Third Quarterly Report

to ·

Jet Propulsion Laboratory

April 30, 1968

JPL Contract 951946

"This work was performed for the Jet Propulsion Laboratory, California Institute of Technology, as sponsored by the National Aeronautics and Space Administration under Contract NAS7-100." "This report contains information prepared by Mathematical Applications Group, Inc.

(MAGI) under JPL subcontract. Its content is not necessarily endorsed by the Jet Propulsion Laboratory, California Institute of Technology, or the National Aeronautics and Space Administration."

### TABLE OF CONTENTS

INTRO	DUCTI	ON	1
I.	FLUID	DYNAMIC MODEL	2
	A.	Finite Amplitude Transverse Waves in a Cylindrical Chamber	2
	В.	Energy Release in a Fluid with Finite Amplitude Waves, Simple Energy Source	26
	c.	Energy Release in a Fluid with Finite Amplitude Waves, Simple Energy Source (Including the Axial Flux Calculation)	30
	D.	Finite Amplitude Waves and Simplified Modified Godsave Analysis	32
	E.	Program COMB Status	55
II.	DROPI	LET EVAPORATION AND COMBUSTION ANALYSIS	56
	A.	The Rate of the $N_2H_4/N_2O_4$ Reaction	56
	В.	The Modified Flame Surface Analysis	63
	c.	The Reduced Godsave Analysis	72

### INTRODUCTION

During the third quarter progress continued along two fronts, the fluid dynamic model and the flame model of droplet combustion. This quarterly report describes some of the effort that is being generated in these two model building areas.

The first section describes some numerical experiments carried out with the fluid dynamic pancake model of the combustor. The experiments include both non-reacting and reacting flow conditions. The status of program COMB is also discussed.

The second section describes recent work in producing a simplified droplet evaporation and combustion analysis. Some recent results towards completing the Peskin-Wise model relating to the modified flame surface analysis are presented.

The authors would like to again acknowledge the creative programming effort that Harold Schechter has provided during the course of this research program.

### Fluid Dynamic Model

### A. Finite Amplitude Transverse Waves in a Cylindrical Chamber

We have continued exploring and analyzing the nonlinear motion of finite amplitude waves in the transverse plane of a cylindrical In the last quarterly report (number 2) we reported on a calculation which exhibited continuous behavior of the fluid properties for all time. The initial data is prescribed by relations (traveling wave solution to the wave equation in cylindrical coordinates) which are presented on page 19 of quarterly report number 2. The initial pressure field and velocity field are shown in figures 1 and 2 and correspond to finite values for the amplitude parameter in the above equations. It should be noted that to obtain the dimensional value of pressure the nondimensional pressure is to be multiplied by  $\gamma p_{\infty}$ . In this test case, however, the maximum value of the pressure is 590 psia while the minimum value is 10 psia (here  $p_{\infty}$  = 300 psia and  $\gamma$  = 1.2). The numerical values shown in figures 1 and 2 correspond to this case. For the previous reported calculation the maximum (minimum) pressure was 450 (250) while  $p_{\infty} = 300$  psia, and there the solution remained continuous for all time.

As figure 3 shows, for the present calculation, a shock wave has formed after about 1.22 units of nondimensional time (time is normalized by  $R/a_{\infty}$  ~ .131 millisec). The wave is strongest at the wall and decreases in strength as it curves inward into the chamber. Swirls seen behind the wave are due to numerical oscillations, a

feature inherent in these finite difference equations. Figure 4 shows the strong discontinuous behavior of the velocity field in the neighborhood of the shock. Now figure 5, taken at 400 cycles of computation, is an intermediate stage of the flow field development. Two pressure peaks are evident at a nondimensional radius of R = 1 of the combustion chamber. There is also a vast region of the chamber where the pressure is approximately uniform and it is clear that figure 6 shows a strong induced velocity field which is predominently tangential in direction. The pressure field shown in figure 7 shows clearly a symmetric compression/rarefaction wave with a peak pressure of about 1120 psia. The associated velocity field, shown in figure 8, is also locally symmetric about the pressure wave. Velocities increase and then decrease uniformly in the direction of motion while the maximum velocity is at the boundary.

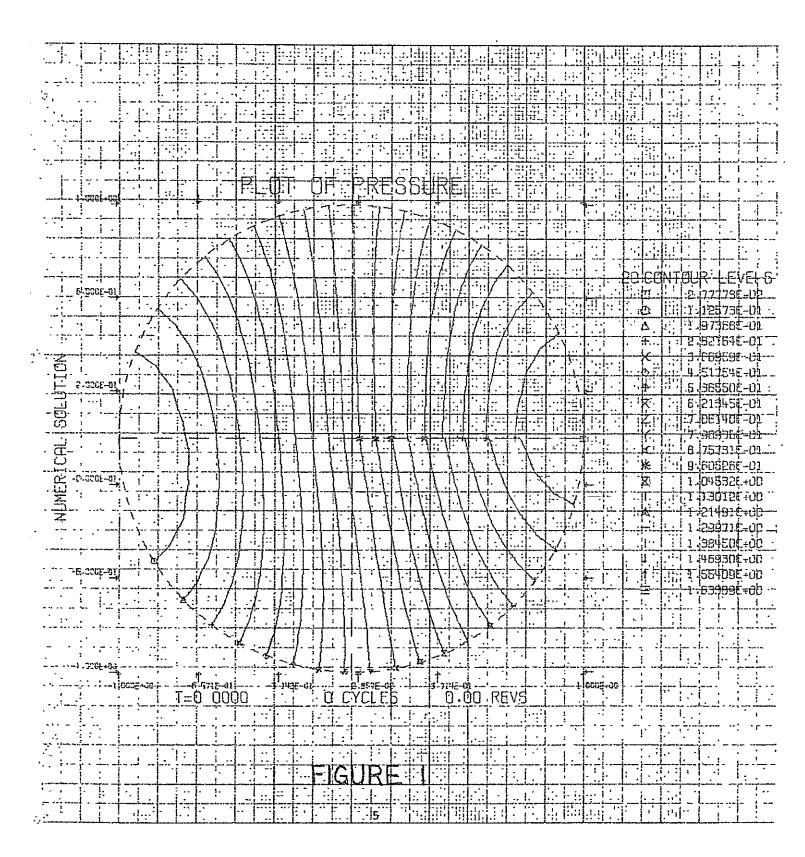
One also notices that the velocity vectors on the leading edge of the wave point towards the wall while those at the trailing edge tend to point away from the wall.

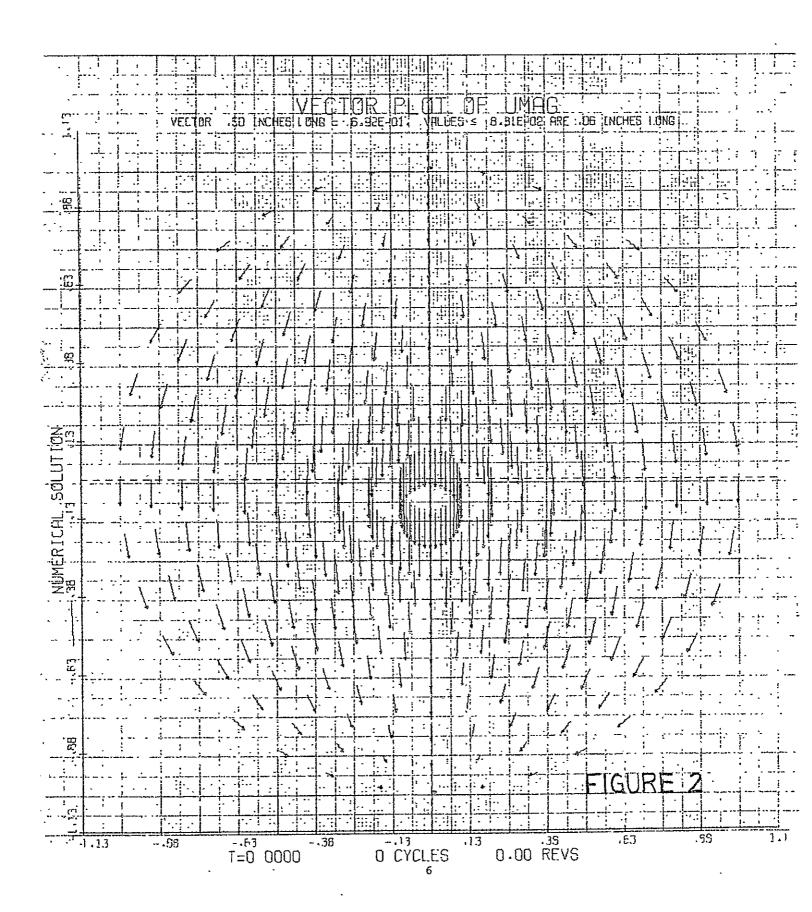
Figures 9 and 10 show essentially the same picture as in the two previous plots; here the peak pressure is 1250 psia while the minimum pressure is 160 psia. The uniform portion of the flow field has a mean pressure level of about 220 psia. The wave has now undergone about one and two thirds rotations in 0.694 milliseconds. Figures 11 through 14 again show that the wave has the same basic structure as seen before, however, the peak pressure is decreasing to 1018 psia.

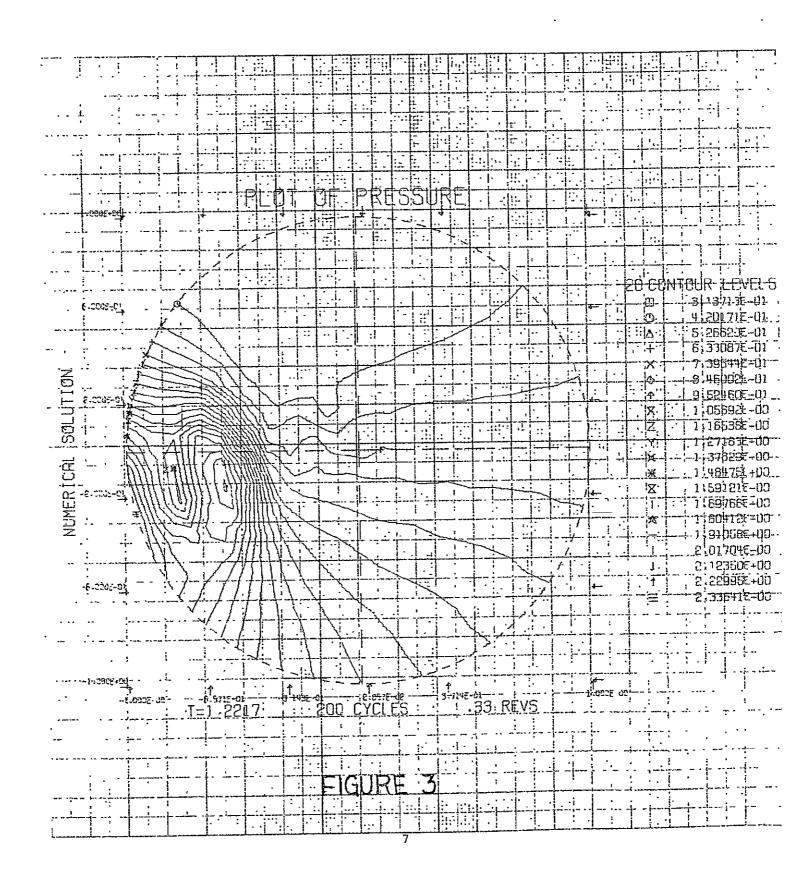
Figures 15 and 16 show the pressure field with multiple waves, waves which then seem to coalesce and lead to the flow field given by the next three figures.

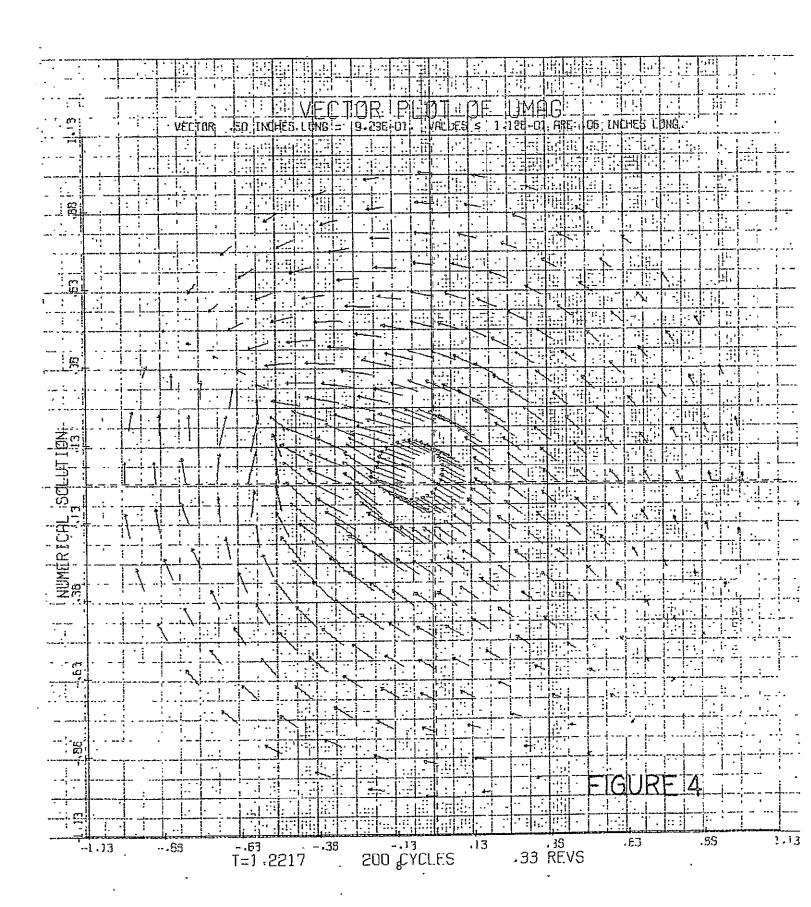
It should be noted that the 'rev' counter value given at the bottom of the accompanying figures is computed from the relative position of the velocity vector at r=0 from its starting position. For small values of the amplitude of the pressure wave, the vector rotates in phase with the wave. However, for large values of the amplitude, the fluid motion no longer is locked onto this convenient measure, but rather, there is in general a variation in phase between the rotation of the wave and the velocity vector at r=0. At 2200 cycles (figure 18 corresponds to a physical time of 1.94 millisec) the wave has rotated about 4.8 times and the maximum amplitude has gone back up to 1350 psia. It is striking that the picture of the whole flow field again looks quite like that in figure 9. Apparently the fluid exhibits time wise dependent periodic behavior with waves of finite amplitude. The average period can be computed and is found to be 405  $\mu$ -sec.

Figures 20 and 21 give the dimensional pressure on the wall of the combustion chamber for selected values of time corresponding to some of the previous figures. The curves are labeled with three numbers. The first is the nondimensional time; the second is the rotation counter enclosed in parenthesis; and the third is the computation cycle count.

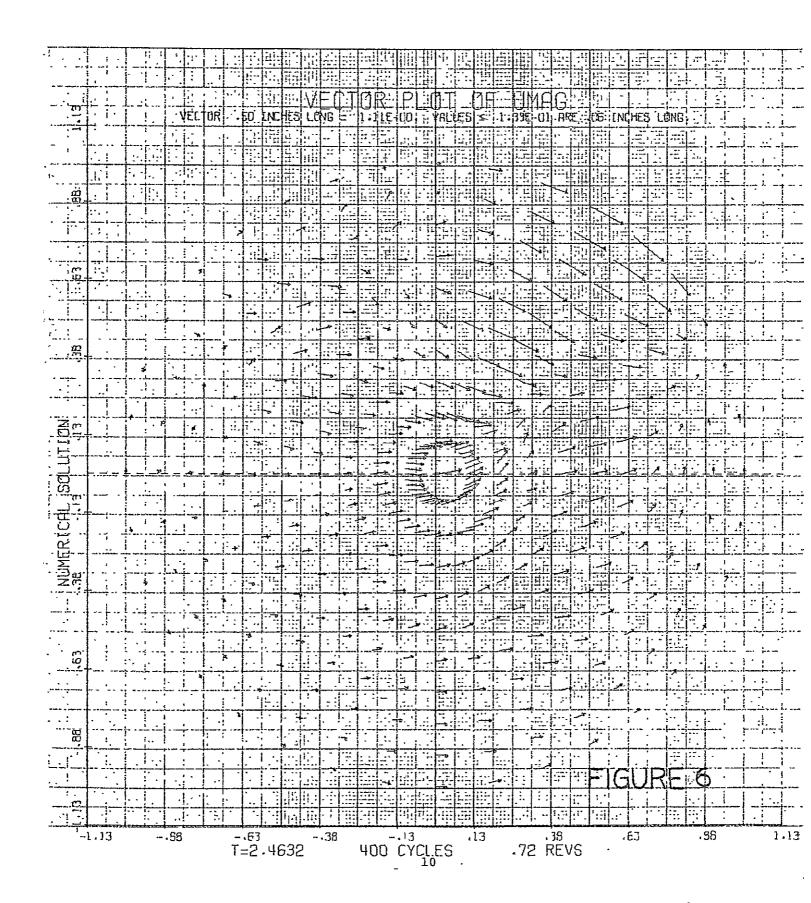




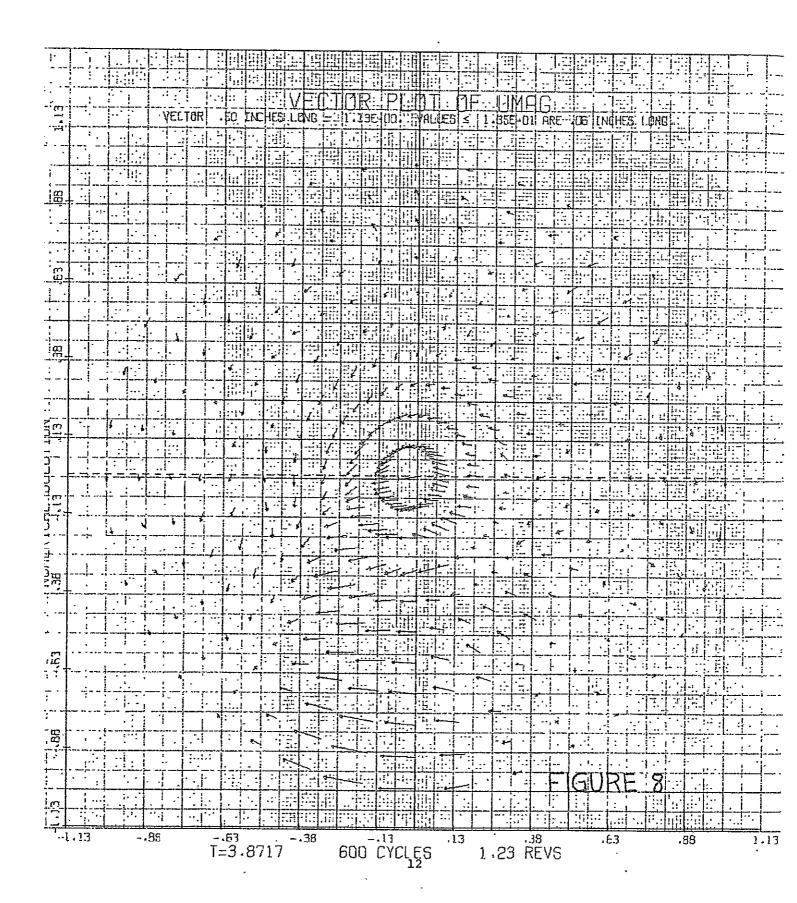




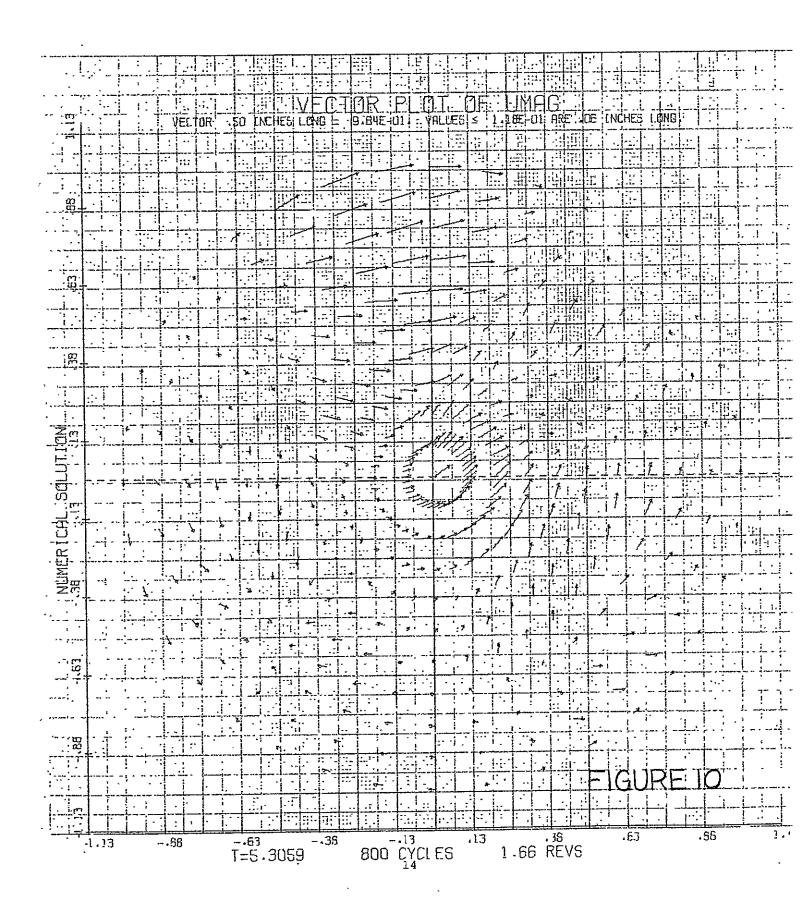
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		<del>omentellant, er</del>	el. Bueldalen kan habia	
	1: (112.51)			
- 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1				
			FSSIRE - T	
	· · · · · · · · · · · · · · · · · · ·	43 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
		71		
				E E E POCENTALE EVELS
				FIFT PRICANTAIN FIVE S
F. DOCK-DI				
		PI WIN		7 - 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
		MACE		A 101 5 95 47 -01
	性性對	<b>对为小司员</b>	NATE OF THE PARTY	人名马斯可尔斯福马纳对764-01
21 121				X 8 8580bt. Ur
				<u> </u>
F 6-200E-55				V==1,0111
	1-1-1-1			/
8117				1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -
				1=1-15178E+00-
	المنتاب المناب	- :   <sub>-</sub> :   <sub>-</sub> :  - :  - :  - :  - :  - :  - :  - :		1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-
X -5.000-61	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\			X 31. 2 04843£+00
医门门 化丁醇	F F 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	MINI DI		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
2				2 9376E-00 2 53908E-0E 2 484 42 400
				~~~~ 7F13
	1-1-12: 1::		1. 月光的人間。	7. La 7. La 17. 14. 14. 2177508E+00
! 3008-01	<del> </del>			事/ 1 2 4 6 4 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
				7/ 2/32041 E+00 3/06574 E+00
	<del> </del>			中国国际自己的国际
	++++			
1.500				
	2.4632		75.65 13.745-41	S
	<u> 2.4632:</u>	:-:  :: 400 : GYC	LES - 1 - YZ REV	S
	1 15 15 15 16			
		3 15 1 11 11 11 1		
			RES I	
				THE PROPERTY OF THE PARTY OF TH
			RES .72 REV	
	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	तु स्तराह तुल सुरू सुरू हुन्हें	9	
		-		



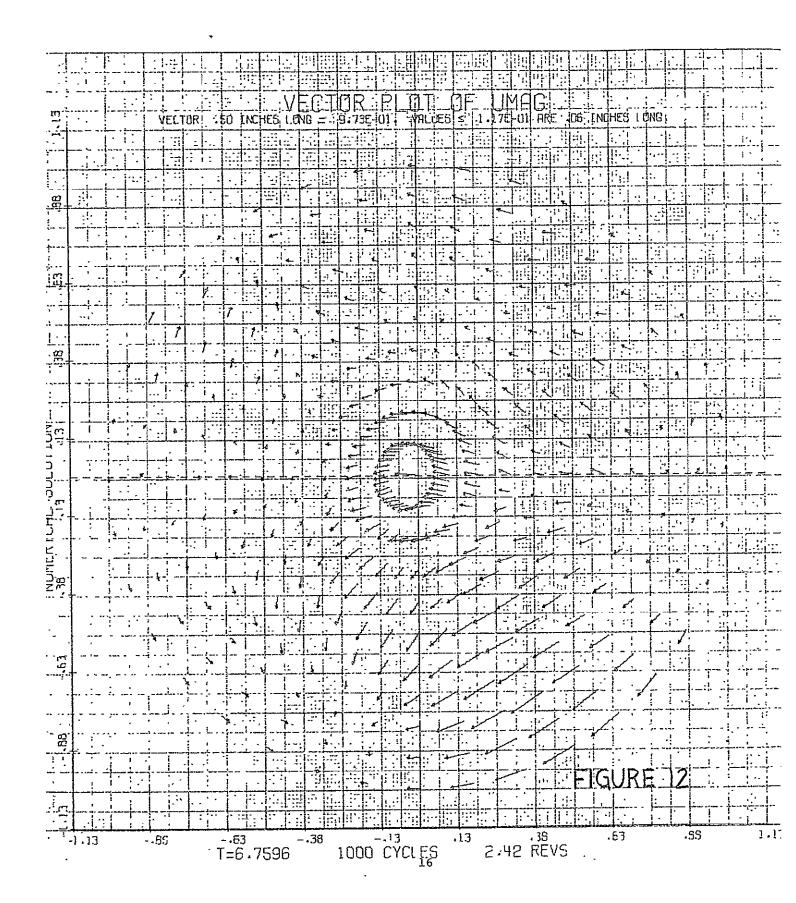
•																								
F 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1177	1.			.11111	MI:	<del>:::</del> :  .		7			1.1	: 7,1		1.7	Ţ		7-4	[i:	-15	11		2 -1	
	<del>                                     </del>	-::::				#1	<u>+-</u>	┨┷╏	-	*::		::4			<u>':</u>					_ <u>-</u>	``]Ţ.	<del> </del>		•
	!!				<u> </u>	4								: !-	بند	ᆣ		!:	<u>i. 1</u>	<del></del>		`L		
		1.1			-1:-				Ξ.		<u>  </u>			1		[:	i			11	٦.,	1		'
注:1 1. 据()		-:		; ;	<u>``</u>	ad.	: :-	'	<del>-</del>		1;:	孙	.[[:]]	1,		. 4	٠,	Ţ	FEE]	FTT.,	` } -	ţ,	i , '	
	1	1,:.	:	•  •	! <i>:</i> • !	-ii  -	} :	1.	: :  -  -	1,31	11:	:,,,	: :: j	1:1	1	- :	•		- 1	1. 1.		2	; , .	
<b>一种一种大型</b>	† ; † ;					1:1:		1		1	15.	E+7		=	1	; ; ; ;	: †	۔'۔ را		1.11 [.].].	-1-	: [= -		
				<del>  -</del>				<del>  `  </del>		1 1	:			-		'!'			<del></del>	77		<del>] :</del> .	Ē	<del></del>
	<u> II]                                 </u>		- i	<u></u>		- <u>!</u>	> <del>+</del> >+		ابد		-:	-			.1.	, [	-	• • • • • • • • • • • • • • • • • • • •			1	Ļ		
1 7 2000 200	1	事.	PL	H 1	191	- i	IV C	10	<b>⊋</b> ţ	î EZ	L.;		. ;	÷i.	,,	· ( ]			111	, ,, ,,		<u>:</u>	<u>.</u> 1	
		.# .				** -	·	1:-:	!	7		1-1	: :	: :	:: ].	: : :	: }	- 1.	1.1		<u> </u>	1.		!
	T-1-	; ; ; ; ;	77		-   -	Y		1		:: '	.:				: 1	, ;·· ·	. 1		11.		1	1:	;-	
<u></u>				<del>                                     </del>		77	·	<del> </del>					· :		-:-	<del>- ;</del> ;		- !	<u>-</u>	#1+1++ =:-1		+		-
		/ ::		<del> </del>	-\:	1	·:	<u> </u>	-:		1:::	:} ::-}	للح	:- -	<u>:: </u>	<u>:</u> :: :	إ:_		<u>' []</u>		<u>- -</u>	4-	<u> </u>	<del>-  </del> -
		أمنيل		<u>L'İ</u> .	:1:1:		ــــــــــــــــــــــــــــــــــــــ			1	-		11	<u>ت.</u>		. ا 		<u>.::[</u>	出	plc	ŊŸ.	i i	R-1-	FUFL
1 6-000E-01	4	1:-	;		1:7:	: :			<u>, ``</u> .~	<u> </u>	: :	:1	: //		<u>, :  </u>	<u>,-</u>  ;	<u></u>	-::	٠ij	. jŋ		 . <u>.</u> .3	2607	ים בים
	事件	1	1 7.		٧.			g	***	:7	111	1	::/[	: 1/	Ţ	F :: [	ī.:ľ	11.	<u> </u>		-			6E-01
1 71	+		<del>                                     </del>	17	النهر ا	.	<u> </u>	K		  ;	7		<b>f</b> :f	1	7		寸	=- ;		Δ,	1			1E-01
				╬	-1-1-		<del>- -}</del>	4		!		\\	4		-/	<u>}</u>			::-}	, ; ;; <del>[</del>				16f0;1
<u></u>	4:1			1.)	17.		<u> :</u>	14				:_]			1:1	<del>/ ;-</del> }	<u> </u>	';:'{ = 1:		- X	- -	<del>- -</del> -9-	::ede	<del>11E-1</del> 11
5. 上上上				<u> </u>		送		$\Box$	. FE	i . j		$\searrow$		./	(. X			إنا	ᆁ		-	1.1	D961	ide+lic
a-2002-01		: // .~			بمرا::	.		1		-/:	Ē.:	- 1	$\sim$	/出	1:	<b>\:</b> ::	11	أيتر	-13	手序	1:5	::1	2495	BE+CE
3 1 7/1	7.1.	11	.::	; i	١١	:;;;		4		14:1		- ;		· ::/		1:1	У			· · · · · · · · · · · · · · · · · · ·	:: -":	1	4039	9 <b>E</b> +00
	لسلمين	4	I <del></del>	<u> </u>			7	1		<b>├</b> - ;			<del>: - </del> :	<del>-  </del>	::	<del>\-</del>  -	-	<u>; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; </u>	$\exists$	:j.z		1.7	5579	is£+oc
	; <u>*</u> -			<del>   </del>	<del>4::</del> -		<del>`</del> }		ü	4		==	_	#	$\stackrel{\cdot}{\rightleftharpoons} \downarrow$	<del></del>	=			<del></del>	+	1.1	7212	<del>iGE+2</del> C
霍士 二十二/	.,:		, ,	سئسر:	انځزا د	4	$\leq :=$	1		<u>.</u> .'	ايت		_1	: 4	位	نز أ	<u> </u>	<u> </u>	<u>-[]</u>				86\$9	lje-cit
2: 1:1	. 1 . 4' . 11	<i>}.</i>		ر برا : <u>ا</u>		لنيا	l .	-	' 1	· ·	ر	<u> </u>	المسئر	<u> </u>		· .~	$\searrow$		1	<u>;                                    </u>				<u> </u>
<u> </u>	7			$(:.]_{i}$	/1. ::	I., T	$\sqrt{\cdot}$	₹. ]		7	$\mathcal{F}$	].		了.			1	<u>⊷</u> ],	r.	. 🗷				36EDC
¥			-7-	1.10	<i>T</i>		-1	1		1:7	· -			1	•:-	;	7		FI	-		15		BE+U
<del></del>			/ .	<del>!,</del> / <del>!/</del>		<del>     </del>	<del></del>		}	۲"			<u>-</u> - -		力	74.	į į				-	7.2	4015	
T. j   -   -   -   -   -   -   -   -		;		1/-1	4	U	<u>~</u>	÷~	1	<b> </b>	-					/	j	<u></u> ‡	إبد	- 11 -		12	1	35E±CK
		<u>/را:</u>	1	11/.	شمل			17	Ĺ <u>)</u>	انا	. ]		<u>ا ب</u> ک	.Д		<u>/¦</u>	: إئـــ.	· 		. 1	_i	1,5		74E-00
\i	1: 1/	ľ		7./4	117.			1	نهر	[ ]	7		Li	Δŀ	_:]	4.	: !	.	-	1.				34E+00
e-500E-0I			1.7	977	18.	-		1	1	1	_ v	. /	/ /		4	,,-	į	<u>,</u> (		<b></b>	1:			3E+D(
a v salazan waifi sananian			ブブ	<i>(717)</i>	14.7			17	15	1	)	7		<u>۱۳۰۰ - ۱</u> ۱ <sup>۶</sup> ۰ در ۱۰ در			-		<del> </del>	<del>- F</del>		13	<del>(25</del> 19	₹₹₹€
		/	1	////	14/7	<b>/</b>	<del>~,}</del>	444	+	1	+:+	-\-	<del>-/</del> jt	7			;		ij			1-	<del></del>	
		1/	117	<i>}}}}}</i>	44	/_	$\sim_{J_I}$	47-1.	14	14	(		Z-+	<u>'.  </u>	<del>-,</del> ;			— ļ		- 1	<del>-   -  </del> -	<del> </del>		
		; ×	4//	[[]]			<u>[</u>	1.1.1.	77	<i>[[]</i>	\ <u>v</u>	سر: السالة		. إ	-:			† 	!			۔ آئ	-+	
	;	- 1	17/2	144/	[]]		1	1/1/3	III	١,٦,			t	1	i		!	• •			<u> </u> ::	}		1.
	, 4	• • •	· · ·	1	- <del> </del>	7=-	<del>-</del>	سيدين ا		P				711		Ī	1		}		7	;	} ,	- 4
-1-604[-60-]-	6.5		7	1-1-1 1-11-13E-	d00	, O	光光	다. 다	: <u>-</u> -	3.7	#E-0	) (2 :	었다.	L VS	!	÷ -;	- +	.0000	: 96±					. `; ;
	T=3	101	- 1 -			낙	1 <u>                                    </u>	۳-		ţ	5		- \ L	<u> </u>			!		<u>.</u>				<del>i</del>	<del>-</del> -
		<u> </u>	<u> </u>	<u>                                     </u>	_ -					1 }			! 				: }		!	٠. اِ دـ	_ :-	; <del></del> -	,- '	
	. !			<u>l</u> F			 					-: !			<u>: :</u>	!	; 	:	·	: :	<u> </u>			;
7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	<del>-</del>	:				[::]			٠.;	1:	.:	j		1	•		, 1		.:			,	1	
	1		<del> </del>	1			TIE	٦لا	7	7			$\overline{\cdot}$				   		·}			1.		
	+ ::  -	·   · · ·	1 11-17	<del>  : -</del>	1 1 1	U	אָר	ت الإ	<u> </u>	1 1	- :   	┝╌┤	12	1.	• . 1			. 1	<u></u> i	<u>i</u> -	#:	_ <del> </del> _	<del> </del>	
1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-	<u>.</u>	. <del>.  </del>		.	-4:-	L		1	- :	1	<u> </u>		- <u>·</u> <u>{</u>	.		4	i		_			· <del>†</del>	<del> </del>	
		<u> :  :</u>		: 1			<u>   '</u>	1"	<u> </u>		: :	٠.	- 1	į		$ \cdot $	<u>.</u>		لــُـــٰ	<u>. l</u>		<u> </u>	<u>l . i</u>	:
								1	1															

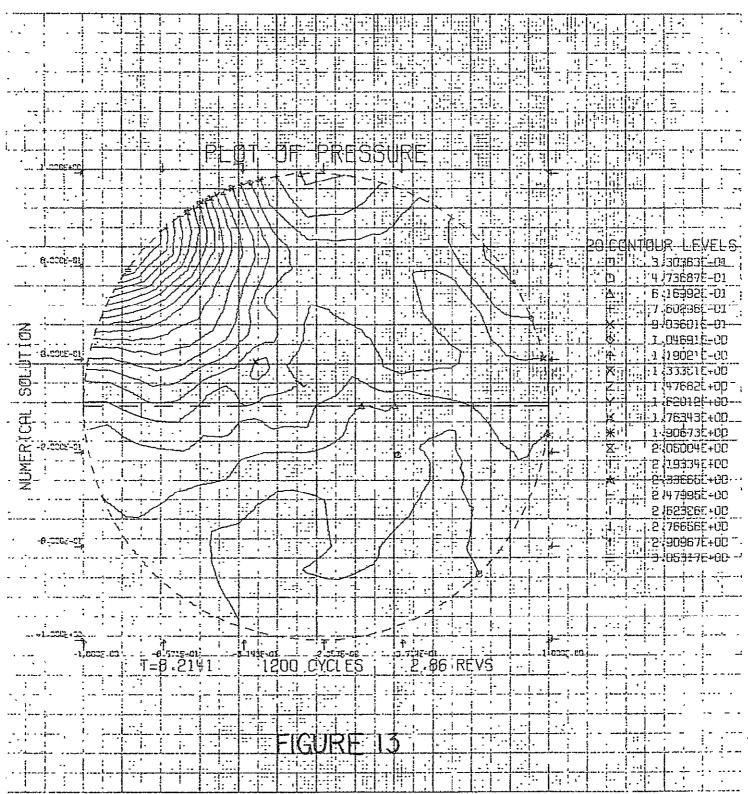


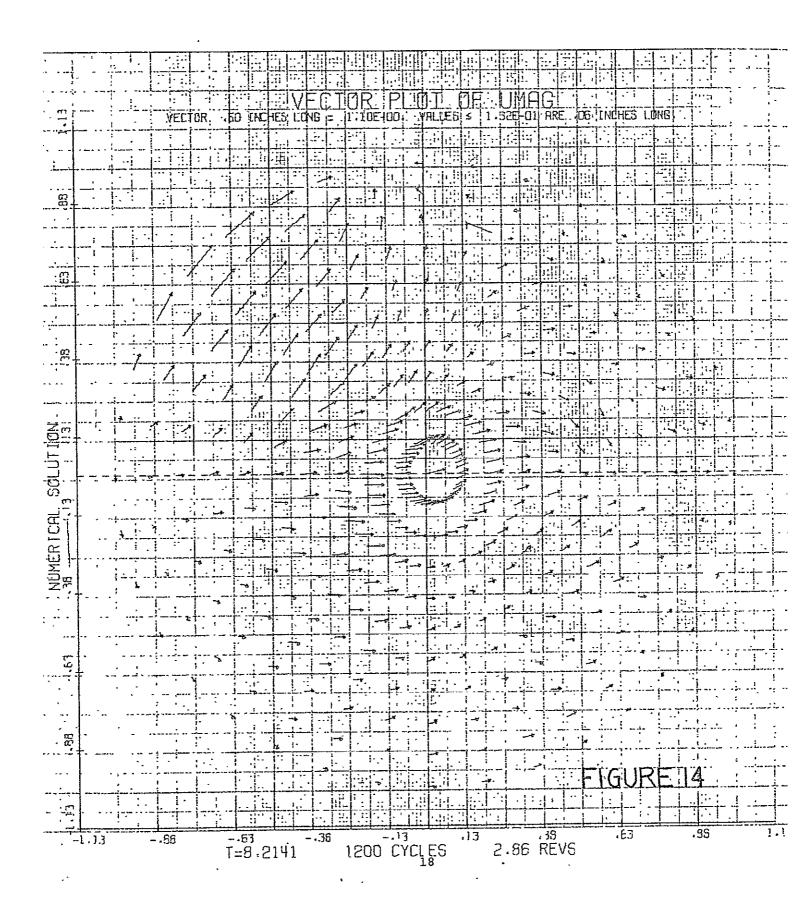
			•					
	1:11 : 1					.   .		
1				12 12 1	14:11:11:11:11:11:11:11:11:11:11:11:11:1			
		1. 1. 11. 1.1					[ ] :	
		1. 7.7 . 12.1   23		',''tli':: ,'   5"				
				######################################		· • • - • • • • • • • • • • • • • • • •		
	1							
	i:			派自2百		1	计图图记	
1 2201-22			5月777	7777				<u> </u>
	+		12N/N/	排出低		11 [-] -, -]	:	
	1			<del>/////////////////////////////////////</del>				
		金黑	三分升					
	14777		\$1717J	####//			L-L-EOICE	NTOUR LEVEL SI
6-300-01	VVV	PER STATE		排队定			1 + 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	
	11/1			<i>7/1/1</i> / 1				::   6:02711E-01
· [ ] [ · [ · ] ].	17.		的电池	组件目	老和軍的家		15   15 [ 25]	7 62177E-01
-+		工业工	有利	ATTACK!	KILL TIP	三年1134	. T. E. E. E.	9 216446-01;
音 //	<del> </del>			£1:1-1-		7 - 1		1 290586400
	111					==  -            -		-ti-1-40004E+0D
<u> </u>	-						X-	1 550515400
131111	1:1-1							1 77 E 30 E + 0E ::
70 1 1 1 1 1								11/11/11/11/11/11
		:   \[ \ . \ . \ . \ . \ . \ . \ . \ . \ .		7				- 15 03 48 F + OD
		-1::1:\:\!				5	EFE W	22 2 129737F+0C
F -6-2008-53 / 1			1.54		**   *   **   **	<u>;                                    </u>	- 1 : X	.2  35684E+00
1 2 1			. : ( = 1) ; ;			1 1 11		2 51631 E+00
	4 4					1 /2		2 183424E-100
	+++					412 7/3		2,99471E+00
	<del>-   -   -   -   -   -   -   -   -   -  </del>	<u> </u>				<u></u>		:.!-3 (15417F+00
		<del></del>				11:4:1:		37313646+00
		4 5/4			[-] - [ X		<del>\ \ \                                  </del>	- 3 47310E=00
	<u>. کمب جا</u> ا					411		
	1 44		1:1	1.1.35.15		#111	F ( 1 - 1 - 1 - 1	
			<u> 11.   12</u>			<u>i </u>	_1	
		1. 7. 41.		1 1 1		1	1	
	T=5.31	1 1	1-800-C	TIT	_ (a			
-1.0005-00		0\$9	1. nns	YCLES	1.66 RE	vs.: .:		
	1-4-4	، ا <u>د لو</u> د	1, 404 1				1.	
·		7	1 1	1 1 1 1 1		<del></del>		<del>  </del> ;
		<u>-   -</u>	111: 1 1:::	100 46 4 3 9			<u>.                                    </u>	
		1.1.					<del></del>	
			FIG	UKH: 1	2: 3.			
	: 1.			kiril sali. 15			1-1-1-	
				hi: [11] .::				
							=	



	•																			•													
		;	7	<u> </u>	Ţ	1 1				1:11	1,4				::.	111			-				1	: 1	:		ž . ž		,	٠٠,	7 :	1	
	{ , <del>}</del>	:- <u>;</u>	- <u> </u> -	1,					-, '-	: <del></del>	: 1		<u> </u>		, ,	-	<u> </u>		= 1							ij	1				::",	· ę	
		; ; ; ; ;	÷	<u>.</u>		7 7	· ·																		<del></del>		<del></del>						· ·
* *		* {	:	:			<u></u> _	::::					-:-		2 <u>1</u>		<u>, `</u>			4.	<u>1</u>	1	-: -i.	,	.;	::::	٠,٠	:			~ -	- :	
	1.	•	. :	* <u>f:</u> !.	Ţ		·	i:					: -	£, `	" !		[٠٠]	-	. ¦		빏	-`}	1, * ` !:		•		٠.	::				i	
*********			7	<u>. li .</u>	Ī	-1	:			14 4			÷.1					.::			.;.		Ę.,	.11		1		:-	٠.				
				1	-}-		<del></del>	1,:,	- : '	1, 1	1	: - :	:::	-			· · ·	=		1	냙		: ::	-1.	-	:::	::'	- :	-		!	- <u>- i</u>	
		<u> </u>	<u> - ļ:</u>	1 **	+	<u>. '  .::</u>	ļ:	-:::	F	•	1111		-	1			- :		<u> </u>		17					. [.]	<del>:</del>	<u>.</u>	7			÷	
:		· · i · · · · · · · · ·	<u>:L</u> :	<u>. j.</u>				<u>:</u> ::	A		7		^ <u>i</u>	?E	: ا <u>:</u> ا	::: 	ΪĖ		<u> </u>	[-					Δĺ	E			<u>u : </u>				· .
1 ,	יייי ליייי	: 1		ί.	- 11	1	₽		Į, l		J۲			( [	Ű	D <u>.</u> ţ	ŊΚ	디	, 1		(in:		4		41.1		Ι.,	: ::		' - -	:.}	ļ	
;;	1	, <del> </del> -	i	<del>.  </del>	ě	.1:	١.			.1.4	٠,		-9-		.÷	: 2	-d-:	•	- 1		: -:::	122	1	::1	7	. ;;	!		٠,.		.,.	· ` !	
			+-	<del> </del>				-		111	#			i;		: [4:4	~			<del>`</del>	t:	<u>-1</u>			7	77						}	
	انساسا	خلت	_ _	_!_	-		2.			: !	<u>.:t:</u>	7,12	/[	1,	<u>. ·  </u>			-1	<u> </u>	<u>:-</u>	# #	:: '	<del> </del>	<del>-: </del>		*::	1.	- ,-	,,,	<u>' -</u>	<del>'+</del>		_ <del></del>
		. i	٠   ،				į ·	ļ.,	1.	.: ;			.: }		:	111		.:".	: <u>[</u> :4		먑	ا ا	ر افت ا		]	نال	: :	<u>:</u> :		:::			
[	1	: . 1 .	-		?	,	<u>ا</u> ۔	Ī	Ţ:	: .	:1:	<u>:</u>		7	i	::	: :.		;		\.;·				.;;.		مأح	; :-:a	. 17	ci.	h 1	_	:- L C
	· <del>·</del>		+	<u>;</u>	حة ح 1	$ \leftarrow $	Ľ	<del> </del>	{	711				7.				- 1:	: ::1	::-	-7:	==	1331	:			μU	ice Ice	ŀ¥ ţ	UU	r. t	ξ-λ	rtit
<del></del>	6.320 <u>E-81</u>	<del></del> ;	÷.	<u>بنہ</u> ، ہر	╬		-	$\equiv$	<del>                                      </del>	FH			-77	={			-::				<del>. −</del> 7.	<del>`</del>			— <del>( - }</del>			<del>  '', -</del>	: · · ·		بلخياتها		
		<u> </u>	Ĺ		1	_نا	خط	<u> </u>	`	لتا	<u>. T.</u>	.:-		· · · ·	abla		F: :				<u>`,1</u> }	انتا	<u>,                                    </u>	_	-	· · · ·		<u>D</u>			102		
; !		٠ :	1	-;/	Ì	1.		۲,	١.,	1:	i	.:7	~,	::		,	,			-		1	1	. :	ا -: ا	` [ ·	٠.	Δ	•	Ę,	E03	53Ę	U1
	7	· -77	7:	-₹	•			7.	1:7	1	ı;;	:/:		1		:,:	7-		.1		1,	1	Ī	• • • •	1::1	1- ;	.337	ή.	Ξ.	.В.	7.09	74 <del>i</del>	01
;- <del></del>	-}	1.1.	<del>-</del>		- <u>i</u> :		·}	<del>:</del>	<del>i /:</del>	<del>`</del> :	1:1	{-			<u> </u>		-					1-1	. ;	\	13		<u> </u>	<del>}&lt;</del>	-	-9	FCC	<del>9</del> 5£	- <u>Ci</u> -
			j	: .i_}	<u> </u>	۲- ا ما	1 	Ц	<u> </u> -		115.	::7			-7-		71.1	/_				<u>  </u>		. \ .	::		·	ф_	<del></del>		110		
1-	3-000E-01	\.`  <u>`</u> .	٠   ٠	^  '::	χ:		١٠	Α.	1.::	<u>:</u>	٠,	÷. ,	7:					- \		·		/ - <u>.</u>		1.1	<u> </u>	;		许.	٠.		260		
1 = 3	:				: 1	<u>V.J.</u> .	1.13		1	.::i		<i>} :</i>	-	:	· ·/	: -	; <u> </u>	٠,	1.	]:[	. 1			: 3	::	1:!:	Ţ.,	X:			410		
SG	<u></u>		*	₹ i:-		خرا	<u> </u>	† <del></del>	17		T	7		(		T=	7		7:	<u>.</u>			 :		77	1.1		Z.	1	Ţ	561	08 <b>¢</b>	TTOC "
1		<u> </u>	4	<u>.</u>		<u>ii-</u>	<del></del> ;	÷	-	<del>\-</del>	***		<u> </u>	<u>}                                    </u>	-			7.		$\leq$		느	- <u>-</u> 3-		<u>: ;</u> [:1.]	J. E	:	<del>\</del>	1:	1.	711	200	::CD-
: <del>d</del> =-	-{	ļ. 	. L		ī		<u>ب</u> ے۔۔	ļ:	<u>}</u>		~	- ``	البر	Ŀ		حا	[ <u>·</u> .				_			$\leq$		-1	ļ	Ĺ	۔۔۔		861		
' <del>(5</del> -	· !	! !	- [.·				]	٠.:	} }:ı	1.1	::)	: ::		.:		ł	<i>j</i> -					- \			:: .			₩.					+00
- 12	5-226E-21			<del></del>	1	)	1	7	ŢŢ	-	•-(	å	1-	;		زا					$\sim$	$\overline{\cdot}$	~	-,	<u> </u>		100	Χ.		2.	261	565	.±00
<u>, 44</u> -	~, <u>~</u> ~~,		-1-		::		į i	-	<u> </u>	<u>                                     </u>		Ţ.,	Υ.	. <del>₹</del>	-	<u>. بر</u>	==			إيب	<u>; ; ;</u>		<u> </u>	-7:				¦r :	<u> </u>	٦,	311	<b>E9</b>	-00
<u>`</u> <u>=</u> .		 		. <u></u> .	-1-	<u>-</u>	ļ		<u></u>	<del>}</del>		$\overline{A}$		Υ <u>.</u>	1-/	K-,				$\dot{\Rightarrow}$	~=			·	<u>_</u>		<del> </del>	<del>-</del>	<del> </del> -				:+CC-
· Z	\$	· \	i.		≟i.	i 	L	<u> </u>	<u> }`</u>	17:	٪،	<u></u>	. ",	1: 2	//	1			•						<u>: : </u>	~	Ŀ	<u></u>	Ŀ	2	E1:1	93	:+OC
,	; ·	. 1	1.	•	-	·		I. `	1	. X	.:::	7	~	Γ,	//	تزكز			!	$\overrightarrow{}$		$\preceq$		<u>:</u> .				;  	١.		762		
	÷		寸	<del>-</del> }	+	<del> </del>	<del>                                     </del>	·	† 👈	<u> </u>	7.	1		7		يحرا					==		7	,	T::		<del>                                     </del>	Ţ	1.				.+00
	e-cach-sil		- 1	,-	4	-يَدَأِتِ.	<u> </u>	\	<u>ب</u> ال	<u> </u>	-;-	1	/	1/7	1	1							,					一市	<del>;</del>				÷ŪŪ
		:	_:_	2	L	<u></u>	<u>.</u>	يمزا	جمعك		7			11	[44	//	_					7			<u>-</u> -		1	<u></u>	i ,				+00
. •		;	-	```	.`.	-			<u>.</u>	[	<i>y</i> :		1	$\coprod$	<u> </u>					<del> </del>					 	_ :	<u>.</u>	. :			:	{	
					7;	<b>\</b> 7.77	ļ	ļ.	11/	1	.: ,	7.	7	71	/ F	1	П			<u> </u>	•	; ]	. ;	į	i. į	•	ļ.	;	1.	Ĺ	: :		•
:			-÷		- <u>;</u> -	· 3	<del>::</del>	<u> </u>	† <i>†</i>		7	-/	17	7+	11	1	1.)	7	1		•			·			<u>†:-</u> -	ı	ار ا		;	<u>:</u>	· · · · · ·
٠	'		:		r		۲	Ĺ	Ų-'	ļ	/	1-1-	<i>.</i>	<b>;</b> }	.]-[	1	<del>├</del> -╁	16.				:						ļ	Ē	<u>!</u> -		. :	
	.inninn	Ľij	<u>.</u>		1	<u> </u>	نما		¥	ا حا		_				库	1-24 1-24		!	ļ		:		٠,	<u>; ;</u>		<u>.</u>	1	<u>.</u>	1	<u>.</u>		i
	it-adoc - de	,	. !	1	1		-		<u>`</u> }	ĽĴ		·	1 - X	~~ ~	<u>'</u> .	i .,	1			- !	i			٠,	geog geog	- دن	1	:	;	i	Į		.1.
<u>.</u> :'	% <b>-</b> ₹	,66326+6	::- :		-6. -¢		ar.	,	.3-14 ;	1[	ŊΠ	. r	.ΛL 5.5°	int-√	5	[ ]	316	֓֞֓֞֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓	12	RH	V9						1.	:	;	1	7	j	
~ ~~ ~		·			- 1	2 2 4.Q.	Ļυ.	÷;	·	7.5					Ρ	<u> </u>									نـــــ ا		<del> </del>	<u>.</u>	<u>.</u>	 :		ة إ	
, ,		-	_	<u>. إ. ز</u>	!		1	<u>}.</u>	<u> </u>	<u> -</u>		<u> </u>	<u>                                      </u>	<u> </u>	1	<u>: :</u>	<del> </del>	<u> </u>	} <sub>1</sub>	RE	·		,		, ;			:·	1-	•	, ,		
ı .	<i>.</i>		:	•			,		j	7. !							-			i			ļ		:: <u>]</u>		<u>.</u>		ļ	· 	<u> </u>		, 
,	1- :				7	1	·i	; ;		į., .	,,,	1.	Ī	:	"::		. :								٠.	ļ: <sub>‡</sub>	Ì	1		;	}	Ì	
		<u> </u>			<del>;</del>	1.	+	<del>-</del>	Ι.	1:		7	TI	זכ	<del></del>	17	<u> </u>	<b> -</b> -	{ <del></del>		\				-		1	į 1	ļī'	Ì	j .	}	
	<u> </u>	<u> </u>	#		بـ		1	<u> </u>	! .	[7]	$\Box$	<u></u>	Ų.	7.	<del> </del> :-	1.1	Ľ.	-		<u>i</u>			ļļ				ļ	<del>-</del> -	<del> </del>			‡	
;	1		·	_::.	_}.	<u> </u>	Ŀ		ŧ	1	ı' .i.	<u> </u>	::	1. :	-:: <u>:</u>	<u>i</u>		<u>  :                                   </u>	-	. ]	<u> </u>	:	ļ			ļ. <u>.,</u>	ļ:		<u>[: '</u>	Ŀ.	ļ:		
:	1	1.7	7		: [	. : : : : : : :	ŧ				1,	,	ŀ	ļ	1==		1::::	<u> </u>				` .	- ]	ł.;		١.;	1.	-	[.		Ι.	;	
:	į	1. '		!		. : ''	. (								~	1			,														





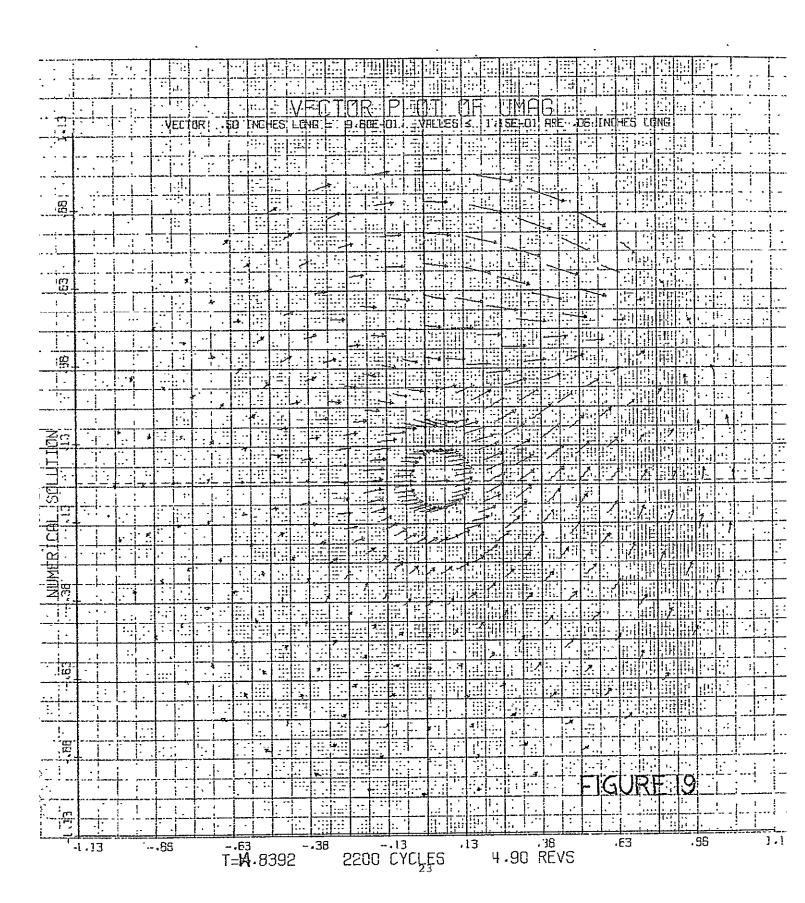


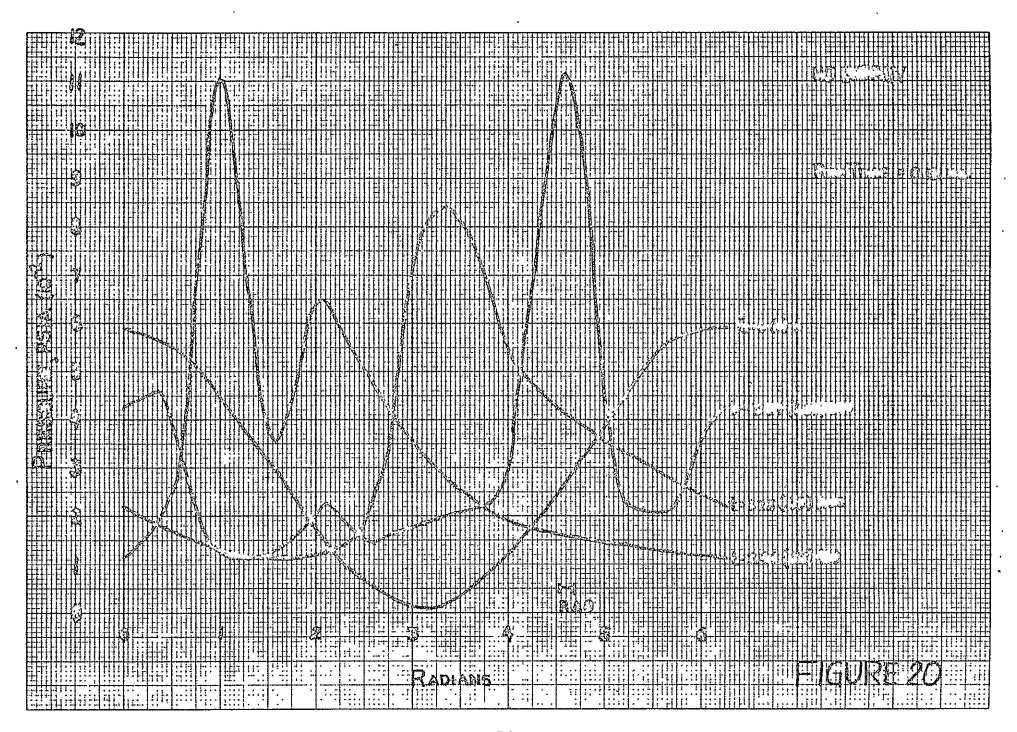
																				<del></del>	,				
	: : :	· !	1	1:	违法,	::  .::	:::!	::	',ill	ļ:   ļ		11.	٠,	:: ˈ[ː	ļi	:	략	:	I.E.	72.1	171	!		٠- أ ،	
			[-]	1:7	:::	ijļū	:		1.	<u> </u>	111		Ē			-	.   :	1:	!				7		,
سيشترسد أسديد	-}	! <del></del> -	1	<del> </del>			1	<del>}</del>	- 41	<del>:,  :</del>	-1-1	.			li Li	+:		1: -	<u></u> 1 . ; .			-:-			
				<del> -</del> :-	$\vdash$ $\perp$	<u>  </u>	-				!·+		÷.+.		\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	<u>-</u>			i-,i		<u>-</u>		}		·
	<u>;</u> i		<u>                                     </u>	1.		1.:	- i	::	ıij	[		- 1	.!'					1	1	:-1,	**;:{		}	<u>. L.</u>	<del> </del>
	1.2 12 .	11 T	E- 1:-	1:		: 1	1.	ŢĖ.	'!	ij			iii:		F. F	<u>`</u> -{;	`:] <u> </u> '	_ ::::	14			: :	i	` {	
		: -	La la				+	1.	:			1.4	11 1	邗		<u>,                                    </u>	. [1,	- , '	11				) ا	i:	
	-	<u> </u>	1 11.	1::	1 :::		1:-			<del>:   </del>		<del>,</del> ,	1, 1	<del>;;;</del>	H	<del> </del>	<u> </u>		1 1		1411				
	<u> </u>	ļ . <u>i</u> .	-1014	<del>di T</del>	L::'}	<del>i ii</del> -	÷	₽ï	C.E	اا-ئخ	$\Box$	=	!* <del>1.  :</del>	111	<u> </u>		:   - }	1 71	17:			-::		;	i
2000,000	<u> </u>	l, II.:	انيا <u>ا</u> اا	<b>Ч</b> : !		14977	·     , .	IVL	Ų.	بريد	1571	٠٠٠ أ		<u>:: `</u>	HE E	· !		1 [1:	1 ::	1::1		لنت	ĿÌ		
				<u>ا</u> ر ا		ZE	: \$	<del>-</del> :-	<b>~</b> ←1.	_	::	. : :	·;-i;		`{   :.		4	1	ļ: i,	;	٠٠,	· -		41	1
177	:	1 : : : : :		. i. :	177	-: ;; -	X	<u> </u>		:	2	Ε.	٠ :		111.3		(;):::			:-	: 1	.::		, !	1.
	<del>-</del>	<del>                                      </del>	<u> </u>	1.	1 : 1		+\-			+		-	ئر ،،،	+++	-::::::::::::::::::::::::::::::::::::::	:- :		<del>} </del>	i		إند				
		1,2	1 -	4.	· · · · · ·	_ات	- -}	. <b> -</b>	سرا	4	-	4				_		4.::			::: :::	<u>;                                    </u>			4-
	بر ا	<u> </u>	ļ !-:	<u> </u>	1	يزا ۽	<u></u>	يخ ا		<u>:. </u>	14		٠.:	<u> </u>	· · ·		·{·			Þή	ca	ΤIJ	٩Ц	R-1-1	-DE1-8
6 700 E 01	1	ļ .	1 3		<u>'</u> , [	#:11.	¥	1:			إزاما	1	SJ!	:::		.   !	511	5:1		II.	Η̈́	=	-3		B01
		1 1.	1	1:	1. ::	1.1.	Ţ	:	;		1:		.	Z		:\\			j, i.,	1	Φ:	:::	4	9290	GE-)31
سنب أستجدر سريت	<del>/</del>	† <del>†</del>	+++	1:	7	<del>` .                                   </del>	+	<del>: -</del>	<del> : </del>	-:-	$\exists$	21	- 1	×į.	<del>] [</del>	1,1	<u> </u>	<u> </u>	<del>     </del>	1.	<del>人</del>	2:27		3905 3005	
		ļļ		-	الحزا		-			+			_	-	_\-	فهسر	<del></del>			<u> </u>	다			6520	
	<u> </u>	<u> </u>	1 11	سسلم		<u>''</u> '-'E-			Ĺ;	-+					7	= +				ļ <u>.</u> -	لنخ		-9-	n) 36	2 <del>i -01-</del> -
<u>₹</u>	•		المر ا	. ·i*		<u>''</u> أب	نبإر	<u> </u>	][	`i]		٠, ]	小	$\downarrow\downarrow$		<u>ن</u> -	ذاسر		·	1:	<u>.</u>			0375	2. ±130:
g.c278-0		1 1 1/2	7.	7 11		7	1	-11:-	:		<u>,                                    </u>	/	7			بهنذ			Ī.	34	ά				71CO
		<del> .  .</del> /	4		· · · /		1 -	1	1- 1	71	1116	7	††	71.	1	7	حاربه	31E	1	1	X.	<u></u>		3095	
=======================================		1-1				<del>} -: </del> ;	7.7			<del>(   </del>	1	[]	: 1	//	<u>,                                    </u>		<del>////</del>	<del>];;;</del>	<u> </u>	17	27.	<del>:: _</del>	Т	4459	
<u>あままし</u>	<u>'                                    </u>		<u>-   ::,</u>	/		!   	4:					<u> </u>	: I	: :	//			4	11:::		Ψ			5821	a <del>t do-</del>
		1-1:	Ţ.· <u> </u>	7:	A V	: 17		1	1			77	$\mathbb{Z}$	7:7	۲)		IIII	<u> </u>	<u>]:</u> :	<u> </u> :	Æ.		1	7182	9E+do-
- P N -	,	Ĭ .		•		7	. :	بسرا	1	-		1:7	13.		T	11	J/L	Ŋ		· ·	派		1	8544	4E-00
- R-3208-91 ; ;	1	<del>;                                    </del>	1 1	1:1	1	سا	丰	7	1 1		7.7	7.1	7 i	77	1.7	Ή,	17.	) <u>.</u>		1.17	X.	. ,	.1	9905	9E-00
· 一一一一	_  _>							خنز		,	1/1	71	f!-	:	7:17	-7-	11			1	Tir	<del></del>	2	1257	*********
. <u> </u>		1	<del>: [: -</del>	نوا	بز الخ	<u> </u>	Ι.	<del></del>	<u>                                     </u>	;~]	<u> </u>	/ <u>-:</u>		<del>:  </del>	7.	$\rightarrow$	1 1 3	- 123		<u> </u>	Δ'		-2	2629	OE+CÓ-
Z ,	1.	<u>                                     </u>	1/./	1.	الجميل		<u> </u>		إسل		إيزيه	-	1		<u> </u>	$\rightarrow$				.τ <del>.</del>			2	3890	БГ≉СС-
	1 :		/ //:	1	] ;}	٠/: الريد	-	سر ا	ļ-	إسر	T					12/	\Y .	: i' _	١.		]-, ,	1.	2	5352	1E-CO_
		17	1	7	1/.1	1.1	.	7		z l	X :	1	7	-			¥	1.	,.,		1.7		2	6713	eľ:+ď?
			1-41:	<del>  </del>	12-			f(t)	1.		>	,	إستع	<del>'//</del>		ŢŔ,	<u> </u>	ا	-	<del>                                     </del>	1		2	B075	2t.+q0
	أكيــــــــــــــــــــــــــــــــــ	·		٠					<del> </del> }-	إسن	Z-	7			->	+			+	ļ	=	ţ	2	9436	7E.¥00
	~~ i			_/\_	انا	$: 1 \ge$	_		<del>ل</del> ــــا	لنسا	مجعد	, /	4	1	烂		<u>:-                                    </u>	_ <b>j</b> :	4	ļ	بنن	<u>i</u>		<u>:</u>	:- <del> </del> -
	1	i[<		1.1	[. ا	1!	,j \	1	[ - ]	از:	إستر	از.ا	1			. <u>#</u>	<u> </u>	<u>j.    </u>	, i	.:	141	<u> </u>			
	1,		4	1.	i. •.		Ţ.		-	٠.:		: .,	اً بر	:				ļ	i	1		:	. :	1.	
		- <del> </del>		-	ij	-+-	<u>i</u>		<del> </del>	<del></del> -		-1	-;-1		<del> </del> -	-	: +:	宇:	·.—	-	7.	į	† <b>-</b> -	·	
	ــــــــــــــــــــــــــــــــــــــ		<u> </u>	لخبا	-		- -		<u>Ŀ</u>	شك	-	'			<u> </u>	+	<del></del>		<u> </u>	<u>.</u>		i	<u>-</u>		
neas.		# d-533E-4	111	<u> </u>	14F-0 k		· į f	. i :57F-(	į		11 <sup>2</sup> 3-7	11	<u></u>					1,00	); );+6:	<b>.</b>	<u> </u>	<u>}</u>	<u>i.  —</u>	: 	<del>-</del>
-1.0035+	T=	9.58	337:		114	OÚ	ĽŸ	CLE	5	.:		3.2	27	RE	٧S	. [		<u></u> .		1.	ļ',	1	<u>;                                    </u>		- !
			1.	1,	Ţ.	1	: [	:		-:_	17.		. i	i				. İ		1-	; <b>.</b>	-	: -		1
		<del></del>		.l	†::†		-1	-;				7	<del> </del>	<u>.</u>	∸ [			1			- <del></del>		:	1	
	; · ; _	4	<u> </u>						<u> </u>		<del> </del>		<del>!</del>				<del>-  `</del>	늯:-	<u>.</u>		1 .:.	<u>.</u>	<del></del> -		
					-	****	: 1		<b>[</b> ; ]	:	Lí	11:1	-: }	- 1		- 1	, II,	! .		1	4-1	ł	i	1 ::	
	; .·.			<u> </u>	1:1		╼┧╌┈	direct.			-	ļ÷ļ	ì	}	<del></del>		i	}	÷+ ∸			ļ	<del> </del>	<u> </u>	
	, <u>.</u>		37.	٠,:	11:01	F (	नि	R	_	. [-]	5	; -:::	·1				***		-				<u> -</u>	<u> </u>	
	, <u>.</u>		.   .	٠,:	11:01		HE	R	_	1	2		i.,, i	· .		: [	***			[;;			<u>                                     </u>	<u>                                     </u>	
	; .·.			- 17. -			E	R	_		2	: ::::::::::::::::::::::::::::::::::	i.,, i			: [						-,		<u> </u>	

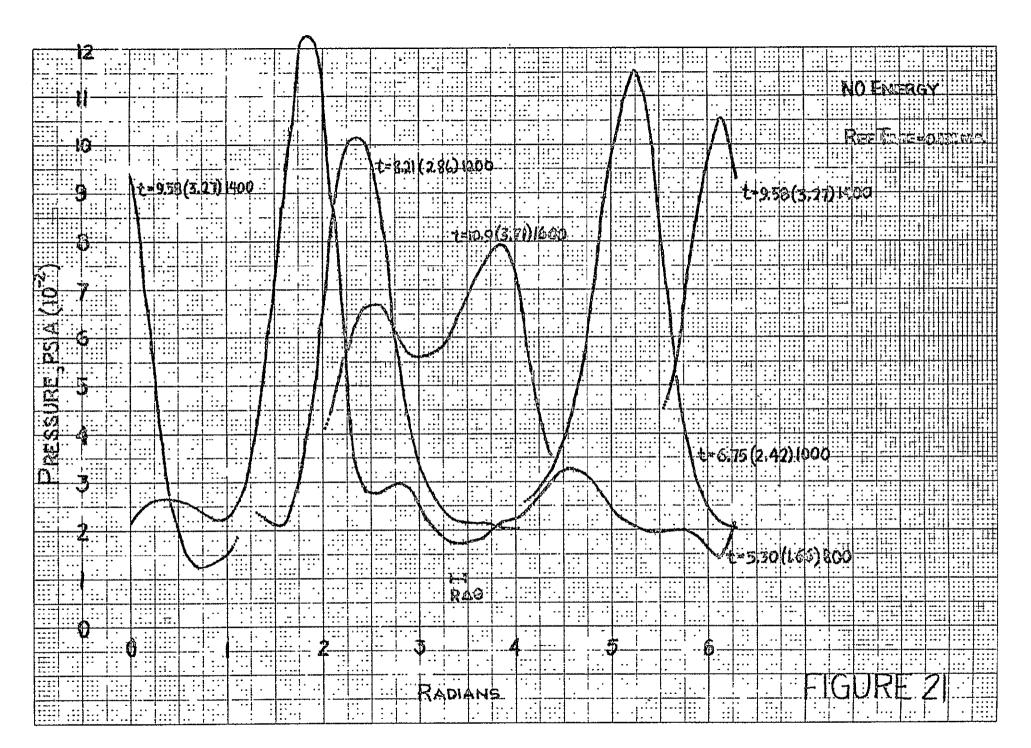
,																				•								
	T .: [	7-1		.////:	;1,	n T	.:::					J. F.	. :		::		11	1. [	• 1	1 }			T	- :	-[1]	24	İ	
					111		1.1		: 1	. 7		1.:				11		. ]		į į	- r	· :			• ]	::	1	- , -· }
				. i . i i				:::		+	<del>.</del>	1 -			i		;						7		. !	. 1	1-	
	·· <del>Ŀ</del>	. :  -:i	÷ F	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1					-	<u> -</u> -	: 1:	:	! -	. :	-1 1	Fi.i		7.	7				1.		t	-	-:	
						-			_			<del></del> -		<del>`</del>	-1-	<del>-  </del>	-ا	E.						<del>, i</del> i	{		' 	
				:'  <u>::</u>	111,	::-		· : -		- -	1	<u>:</u>  :	ļ <u>.</u> -					<u>! : ;</u>	끜		<u>:-</u>  -		1 1		<del> </del>		:	. ;
	<u> </u>			:1::1:	i- '	·		_	<u> </u>	1:	_E		I		-	::t:!	-+			<del>:  </del>		<u>.</u>	: -	<u>-</u>			- <sub>-</sub> -	
			· · · ·	⊃1.—. ∷i∵i	; ;,		٠		):  : 	=	اجے د	: -i-Ð	!-, 	:::		# ! 	- :	-	<u>= : :</u>	<u>-</u>	<u>.:ˈ[:</u>	; <u> </u> ,	- '		<u> </u>		<u>.::</u> .:	
1 Pons Poli					ļ. 1	. 4	<u>, [] ,</u>	. [	<u>'I</u>		) <u>(</u>	<u> </u>	_		·	;#¹1		1:1		<u>'</u> ;'	'   <del>-</del>				<del></del>		].	÷
3	1 1	:	. :			$\leq$		_	. 7	[ ·;	- إنظر	· [ ·	<u> </u>	÷	<u>.                                      </u>		1	<u> </u>	::[	-, ; ;-	<u>.</u> [	_! !-		٠,٠		<u></u>	:_	
				月季	[ .		Ņ.		7.	: 1	Z  :::	: :	ابار 1		.:			;= ;	- 3	• • • •		1		= '-		<u>,</u>		<u>.</u>
			17	N.			$\overline{\cdot}$		-	: \		-				71	<u> </u>			1	3.	: -		1	٠,	. : `	1	
-1:+-:-+			7	-		H		4	1	_K		I		T 1 1	71	,,,,			1					र प्रकृ	311	ا ح	_0	=1 C
				-			<u> </u>	A		$\mathcal{X}$			1:2	<del>  -  </del>		7	<u> </u>	1.	.,:		1.4	<del>U ļ</del>	اباد	41.	JŲ.	(	<u> </u>	ei ei
. 10-1000 31:					1	1	- <u> </u>	=#	<u> </u>	-: }	<del>``</del>			1	7	慧	泔			<del>- '</del> †	訓	—Ë	过		75	2108 2108	-14-	-C) -U)
			\.		<u>k:</u>				7	~ <u>~</u>	7		+	-	-/	7	- 7	124			17		:::	••••	5	71.79	<u> </u>	-G1
			1		1: >	 Sz.	÷Ź	# .	-\	<u> </u>	<del>-  \</del>	<del>   </del>	1:	<i>Y</i> (		겦	<u>h :  </u>	-X:	: -	<del></del>		· †		_ <del></del>	Б.	ยราย	n <del>1</del>	-01
"	1	<u> </u>	<del>}</del>		ļ.,	::::	-	$\searrow$		4	7	4:)	ļ.,	1./	14	12	-4					<del>}</del>	$\leftarrow$	<del></del>	7.	9247	<del>ال کا -</del>	<del>-0 -</del> -
·6·	1		<u> </u>	<u>∵Έ</u>			·/~	===		<u> </u>	717	7,7		1/-	/-/-y	/ <u>[                                   </u>								<del></del>	9.	CZR:	118-	-01_
☐ 5 630£-01,	7   .   .		1::1	1: 17	]:.¨				ال:			$rV_{i}$	1/3		7.1	ŽΪ		**	1	_			X, ' =	<u> </u>	1	<u> 19131</u>	걕-	<u>-00</u>
			7:1	1 12	1	; <u>/;</u>		٠٠;	, E : 1\	<u>;</u> ; '	: 1	<u>,                                    </u>	تزأر	///	F	4	١. ١٠	لزز	1	<u>-` [</u>		<u> </u>	<b>₹</b> -1	-14	:1.	1235	115. Sevi	-60 -60
, g	.								17	, 'A	1		7	7(1)	111		44	`.:-		1-1	:	::::{			11.	F:325	not-	-1100.
		<del>**</del>		70	#15		<b>;∷</b> {	-6	補	7	7	N/A	17	河	1999	3;		المتعدد		::::	· : ; :	::: [		1===	1	4545	274 204	-04 -11:5
	: / : -	<del></del>	\		<del>  </del>	: .	7	<u> </u>	<del>-</del>	汀	7 V.			4	S					- 1		-='[	Æ		ĺį.	5648	39 <u>8</u> .	-00
~ =210701-n1			<del>                                      </del>	11.		<del> </del>	7.	_	#;	$\forall$	<del>].</del>   ~	<del>/  (</del> -	: }_	乊	7		7 7		¥		٠,,,	1-5	ζ	· î	1.1 .	F758	238	-00.
-: <del>[] - :   -   -</del>   -   -   -   -   -   -   -	<u> </u>	<del> -</del> -	+71	111		<del> ::</del>		: <u>:</u> 1		7		行	Ü	$\pm$		سيد <u>ن</u> . سيسر	7.1 <u>∦</u>		<del>Ż</del>	<del></del> †				F. 1		785		-0ċ
	\``\\		- 11	;;;	1-7	ļ. :-		: <u> </u>	++				-	+		=	:: [	7	?:::			,	7::		1.	<del>kat</del> :	<del>124</del>	<del>-02</del>
	. \	·   '	<u> </u>		11/4	<u>  '</u>	<u>::.</u> ;	:::	<u>;:</u> †	<u> </u>	<u> </u>	Þ	Ţ	*~		: 11:					!!		1.6.	. 1	-2:	COS	<u>17</u> 4	+03
	1 1			:: ::	: :\	1	: 1		7	<u>!                                     </u>			<del>)</del>	╁		4	11.	·./:	11	.		• •	<u>' :</u>		123	1111	51 <u>4</u>	<u>+UU</u> _
	\	·	1. 1	iiii:		<u>Y:::</u>	121	-::	بزرد			XI.,	<u>/: ::-</u>	<u> </u>	*:/	- 1	<u>:::</u> ,	,;;	' - -	.: :	- ::		·	1::	1,2	500	३०० इत्य	-up 2 <del>1151 -</del>
	· . \ \.	11	:   ' :		<u>. [iji</u>		<u> </u>	$\cdot \cdot \cdot$	: :			II.	: /.		/	J <del>.</del>	<i>ī.</i>		-::		111				9	14431 14431	351	+ <del>00</del> -
	:	١, ١			ن ان		:- •	, ! :	- +	: (	31,1:		11:	1.6	÷. ;	آرز	-	::,		<u>:</u> :		•••	1	<u> : :</u> :		<u>   </u>	: ]	<u>: .</u>
	- 1		1	1. 11		1			;	Fi. ]	51.	1.	- [ξ	]:	, v.	批	-::  -	:	::!.	: <u>:</u>		; ŧ:	٤.		<u>  F'</u>	<u>j - 1</u>		<u>.                                     </u>
	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1		15		Hi:	1. :	5:		:	::: /		( €	:[.	Y	:::;		115	::		;	÷;;		1;;		٠.			
		<del>                                     </del>	<del>     </del>	3.1.1.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.	1::	<del>                                     </del>	/:			-/	. ;	i.				711	117	,`			į		11	1			.:	
1 000 100	<u> </u>	=12:		**. 1 **	4.	<del>  .i</del>	-		<b>3</b>	4		1	:	07	<del>  -</del> .	112	1	<u>}:</u>		<del>}</del> -	<u></u> .		;	Ī	::.			-
	doct &	-6 5-	إنظا	<u>:  -</u>	ᆌᅝ	ali oi	5		195	E- <u>i</u> p}	$\vdots$	++	71 HE	쒼 <del>,</del>	b.	11:	<u> </u>	+	}-	a <del>ect</del>	gg.		<u> </u>		#			
			<u>.1 78</u>	<u> 8-1 :</u>	-	16	μŲ	<u>                                     </u>	11	1.	)	-1	4.	4/	11/5	V 10		1	<u>' '</u>		-	<u> </u>	1 .	<del> </del>	+÷	<del>;                                    </del>		
	1: 1	<u> </u>	1:1	<u> </u>	1:	-	<u> </u>	: :	<u>:</u>	*:- 1	<del>- 1</del> :	<u>:  :</u>	+	-			<u> </u>	<u> </u>	<u> </u>	į	l 	•	1	<del>] :</del>				<u>.</u>
		<u> </u>	: : :	· .   ' '		1,	111	1 - 1	3	-:-1	i i			-   -	<u>  :</u>	<u>[</u>		<u>l</u>	<u>.</u>					<u> -</u>		<del></del>	!	<del></del>
					j-		1.			ال	]		<u> </u>	_	i		<u> </u>	ļ.	ļ			ļ 	<u> </u> :		Ţ	· ·		
1		;   .				-	FI	G		₹F		6	_ :		<u> </u>	 		<u>L</u> .	<u>                                     </u>	Ŀ			ļ.	1.	1.	.ļ,	<u>'</u>	
					1:	į	1	 [	<u>, , , , , , , , , , , , , , , , , , , </u>		-		<u>. 1 </u>			ĺ	!	1	-	<del>                                     </del>		<u> </u>	¦ .		1.:	ً _ ل	<u>:</u>	
					1	1	1	177	; ;				<del>.</del>	-  <del> </del> -	1,	1	ļ	1-	<del>                                     </del>	1		ţ	;	1:	1			
1 1	' '		<u> </u>	<u>' i i i i i i i i i i i i i i i i i i i</u>	.1:	<u> </u>	<u> </u>	<u> </u>	<u> </u>		ئـــــــــــــــــــــــــــــــــــــ	سلنت					<u>.                                    </u>					·						

					<del>.</del>	: [	<u> </u>		+I	-1:1	1		.21	15.	E 1 E . 1	1	= .1	: : 1	::: 1		•::1	1:1	1111	1111		. 11	111	• ;	- ,1	:	<del></del> -	,	7
				i		<u>i: 4</u>		Щ		-F1	:::		1 - 1	11		==					-∷}		1::4	11.1		: :	::4	11.11		<del> </del>	i	٠.,	- <u>i</u>
	1 :		<i>::</i> ,	<u>:: </u>	- :	.'!!	<u>:! </u>	- 1		<u>:::</u>	: 15		41;	1.	<u>.                                    </u>	<u>.:</u> .	:::	:	<u>: :  </u>	1	<u></u>	<u>: :</u>	3-1	4		•		11.		<u>:</u> :			-‡
	11			اً ٠. اــــــــــــــــــــــــــــــــــــ				:: ::		==	-		Į:	;;;;			:=:				<u>:</u>				Ξ'.	<u>: : </u>	<u> </u>	- 1		; ;			. ;
	1. 1			•	: ,:	٠٠.	-=:		##		::1		=:	٠.	ī: ,	: ::		- =	:=:	==-:		·: ·	. ::	• -	2111	1		•:.	.,	1	· i		
			- 1		:: •	.:			7	; ; ; <u>,</u>		:::1	!::	٠;	::	•	E.		:: 1		- ,	2	115		11	1:1	ţ,	ig.	, ,	, ,	-	:	•
المناج المراجعة	T	, ÷				1: -		=1.	F F		.::		. 1.			11.5		::		==		٠ <u>÷</u> ,		7		÷, i	٠:	. ,		. ]		1	
	+	:		<del></del>				===	<del></del>		1	=	<del>.</del>			•			1.	= :		77.	Į.	11.	13	1: 1	ĬŢ.	či	77	7.1	i	:	_
··· i·· - <del> </del>	<del></del> -					;;;		₽:	: [7]	7	-[	IF	:::f	₹:⊨		-		<del>: ;</del>			1111	1	:	<u>:                                     </u>			7	7 1	-;	·—:			-
	<u> </u>	<b>,</b> —-		1				1			: <u>-</u> }	ξ.	-7-			4				711-				<del></del> -;		:=-	Ŧ	11.				<del>-</del> ;-	
		·	<del>-</del>	<del> </del>		* ;		7	7	<u>//</u>	//	[-]	<i>  </i>	H.	( <del>-</del>	<del>.</del>	-			_:_		1 5-	17.7		<del>jî</del> r	117.	排급						
			Ļi			7	Z	- (	: (	<u>{</u>		٠-١٠	7.7	-7	1	تجرا	)	×,	;	; <u></u> -	-		-	::		-						!	-
	<u>. L. i</u> .		l	مز	1		$\leq$	<u>\</u>	· )	<u>;;</u> ;}	7	7.	/	1	<u> </u>		24	12	<b>X</b>	11:	15.	37.	==		7		, ,	113	إنا		ļ		-:
1 1 1	1.		1		-	<del></del>	~:			7	1	1	<u>\.</u>	<u>\`</u>	سنيت		برز	//	11	X	i: ;				7	20	Ç	ТИ	36	R-I	<u>E</u> į	ELE	<u>}</u> _
6 0001-0		. /		سبا	·.T	,	<u>``</u>		. ~	بكر		,	7					أحمرنه			<u>ķ-</u>			-	. 77	11.1	11-		ч.	474	56		<del></del> .
		1					;	Y.				· · ·	7	بز				1	./.		×		1	[ <u></u>				1,41	5	E75	394.	-C1	
	1.1.				1.,	7	::1:	<u> </u>	<b>X</b>	::-		۲:	Ŋ.	<u> </u>	17.			بر بر	É.,		7	:X:	三	7.7.1		- :::	ăH:	- 1	.Б.	<b>57</b> 6	234	-01	1
			<del>;</del> ,	-::		Y				1		Ţ.,	1:::		ر مندا	1	بنر	::	7:	يزر	1	i= ?	\ <u>L</u>	11.1		i il			:8,	4/-	064	-61	
2	171-1	1:-			::-{	<u> </u>	=	=		7		1	F	بست	ببنر	<u> </u>				V:		::::	A.	.j1:	11	[[*]	11	1111	9	277	<del>983</del>	<del>- L/-</del>	ᅱ
	<del>- /- -</del>	1	<u>  : .  </u>			┝÷	* : * .		1.12		: <del>.</del>	72.		-		, E	- 11	1	/		<u>-</u> -	1.7	慌	=		1	٠ <u>٠</u> ٠٠	li i	'1' .	187	87.F. 966	±GO. ∡rh	! İ
S control	<del>-</del> }\}	\ <u> </u>		<u> </u>		<u> </u>	:: :		: :1	->	:			1:			<u> </u>	<u> </u>		 		<u> </u>	1,13		: <u>-</u>		<u>Y</u>	1117			044		
PIDS	1/2	Τ.	1	<u>ښزا</u>		<u>[                                    </u>				12.	35.		12	1:/		<u> </u>	2227	1.37	<u> :.:</u>	==;	12	1111		: `I.		7.5		1:	:L.	408	120	÷CU	
- W	·1 · 1 ·	:	$\succeq$	<u> </u>		::	Ĭ			Σ	ī.		14	<u> </u>	17	]		2		Ľ.	F	::::				itti.	21	#:	ļą.	528	<del>2:</del> ‡	<del>-66</del> -	H
a l		Ţ.,	1.1.	<u> </u>	:::	1	1111		1 :		$\subseteq$	::::	1	Ľ	-4:	Œ	:		1. 5		1-1-	: : :	ΙĒ	<u> </u>	1.11	1313	Ē		<u> </u>	EAB	297	+Бþ.	
	Th::/T	.	: -:	.::	Liv	.,		: T . T	1	: i ;	X	نرب	[i].	1.		<u>.</u> f::		;:-	<u></u>		F		7	ie:	.,ī.	1111	<u> </u>		11)	76E	<u> 37</u> E	+CC	
- 101: 10:	32, 1	V.::	1		.:::		: 4	:-;-		1	1	:-1	1:11	1 (	.tti	\	•	1111	F .:	-::	:E	===	=7	<u>-</u> .	1:1	: 4:	<u>K-1</u>	Ē	17.	888	464	+CD.	_
<u> </u>	1	1	1	1	}	1	;==;			ij.		111	占	1 \		7	==-		24.5		量	==	17	;_:	::				民	1.00	1041	+6Ľ	
7	17	1	17	<del>  .</del>	7			ļ.,.	1	7	1:;	L i	11.	7	     1: /	1:1:	1.1	: 1:	::::	=	1	!	1/2	T	ŀř	7+1	ři.		15!	יייביי ייביי	73	տար. Հրի	:
		-  <del></del>	-	1	71	1		11.	1	1	ļ. <u></u>	1:51		1	!:::	<u>∤</u> :	1					-: /	Ĺ.	,÷;	101	111,	Ti		<del>  </del>	136E	796	+CD.	-
	+++	+-	##	<del> </del>	1 :::		1 1				نبذ	γ΄.	Ш		17	. :	1:55		===,	::		7		<u> </u>	.:	17.	F.		5	486	88	÷60	- 1
-6,000	의 (* 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	12	1		1 1 1 1	3			1111	151	7		1	:[-}	1.7	1		= -	-		1			1.5				Ħέ	GCE	92	-00	
-6 000		1	<u>/</u> _		17		7	=	-	755		-	1 11		1	1-							171	- 1	-1:			1	₩.	729	<del>1574</del>	÷Ūį	=
	<u>:                                     </u>	4/		1:	17		<u> </u>		陆	<u> </u>	<u> </u>	1:	1.4		: تنال. : حرا	, <u>, , , , , , , , , , , , , , , , , , </u>		<u></u>		: <u>بر:</u> ا	10	= = =			175		1.	. 117	14	.,			-
		1.		<u> </u>			1-7:	1	:=:	≐				1									=			1 1	171		Щ	<u> </u>		·	-
	1 : 1/.	.	1.1		: : :			\	7	111	=::	1: 3	1:11	<u> </u>		1		<b>#</b>		==	-	1		1: 1:	1.3	:::	:::		'	1::		<u> </u>	-   
	37	1	T.:	]					<u> </u>	<u>:</u> :.;	j	<b> </b> ;::	1.	::	يخزل	7.:	ĺ::::	1.2		1	1	ĿĽ		<u> </u>	1:	1:::		il ;.	<u>;:</u>			<u>: </u> :	.::
-   -   -   1   1   1   1   1   1   1	3/ 1.	1	1.	<b>\rightarrow</b>	;:	1:		<b>†</b> ;		1	1:	1	17	بميرا	1.15	₽.	ا ا		į: :		lë	:.		hin	1.00	::i			į			<u>.  </u>	
-1000	10325-00	1:	1 1 1	10.71 10.71	531 831	$\overline{q}_{2}$	1	1-11	2	ATT.	1.7	Ϋ́	ZF	<b>a</b> :		7	4 ; {	10	R	V	3	1:		005	[:,	:::			L		,	<u> </u>	
		1-		IDC.	1::	-	<u>;</u> ;		=: :		1	1::-		Ţ	: ::			.:	ij.		1::=	: :	1:	<u>   : : : : : : : : : : : : : : : : : : </u>			1:1	11:		Ţ-		. !	
1		<u>- </u>		-	1	1::		-		/-	1::			1:-		<u> </u>	1	-	: .:	: :	<u> </u>	1		1=	+	1:	1.	#:	ii.			<u>!</u> -	
		+-		ļ	1 -	<del> </del>	<del></del> -	نزا	<u>) /                                   </u>	1:	<del> </del>	╀∺	15	-	1 = 1	+-	╬	<del>-</del> -	1:	- :-	<del>-</del>	<del> </del>	-}-	.	+-	<del></del>	17.	1.;	1	<u>.</u>		<del>-</del> -	-
		:-				-	1	1.		-				<del> </del>	1	1.	<u> </u>	<u> -</u> -	1.	] <u>·</u>	<u> -</u> 	+-		+-	<u></u> .	<del> </del>		+::	11.			}-	
					]	يرإ	1			-	G	V	K	7	14	1	Ţ. :	i.	ŀ	-	<del>  .</del>	1:	1:::	ļ-: <u>:</u>		+-	- 1-1-	4	<del>  :</del> -	ļ	<u>; — </u>		
			1 .		بمرز	<u> </u>			1				X	1	17	1:::			.  - ·	!	1:	-		4	1 :	( )	1			4.:		<del></del> -	
			;;;	j.	: :	1:		1.:		· :				1 [ [		!!!				1	:			<u> </u>	Ė	1 !		<u>:lil:</u>	1	<u> </u>		!.	•

	<del></del>	<del>-</del> ;		17.74				- ; -			1111							.,	1		1-1		- +-)				FF: 1		<del></del>	1111	1 50				
i	ļ . : _		. i ·			] [			<u>.                                    </u>			115	3 : : : :		ij-		1:1:		· <u>i</u>	<u>::</u>	· . ; !	:-: ::		1: 1	1,1	12:	H	<u> </u>	1211	:::		[:: <u>.</u>			[
	: 	-ļ	<u> </u>		• ]			-:-		1::-				<u> </u>		:				<u> </u>	.113			: .		<u>": .  </u>	::: :::,	-1.1	<u>.::</u> :	, T I				<u>·                                     </u>	·
. •	ļ		, .		, ,	·Ì	٠, ١			١.	٠	:::1	7 1 T	-	i.		• • • •		=====	: ::		11 1	<u>.</u> .	, i		1 1	į.	::!	1, 1	••	. !			,	
, , , , , , , ,	T :		!		i			,			; : :		,,	:: •	†';}	- [	;;;; ;	; <del>-,</del> !	71.	::::		#	<u></u>	;:- Ì		! <del>=</del> 1	111	п;,	ī.F.		:	33	. !		ŗ
						11			: ;,	î.	.11			·	1,17	.:!	:::		1.5		<u>-:</u>	Hii.		3 :	==				:. E	=;;		i,		, ,	
			. i		l. I						=		;			-,						ŢF.;		-15	= :				111	;		ij.	; í		:
	<u> </u>	<del>-</del> i			<u></u>		++++				7		7,1	7.	= -	1.	=			==:	•				 	<u> </u>			ភះ	, , ,,,	<del>:</del> -	-1 -	1	٠٠.٠	i
- ‡	- 1		<del> </del>		ī		:	P		i		1		PÌ	₹Ħ	5		ŀ₹	F	<del></del>		 			- 7-		· <u>-!</u>				<del>-</del>	-			- '
	leui <u>k</u> -e	¥	<del>-</del>				- 72			<b>.</b>				<u>.</u>				4			- ' '	<u> </u>	'	-	== {		11	: ;;	====	'		; ; ;	<del>,</del>	;-	
. شيؤ شد	ļ:	<u>. L</u> .	نِدا .		. `  		ــــــــــــــــــــــــــــــــــــــ		<u>.</u>	-1	- []	7.	1.	1.4	f/J	ĮΪ	<u> </u>		:	: ;:· :::	<u></u>	1				:	11.	Ŀ <u>.</u>	: 14	: ::		ļ	<u>-</u>		3
			4	<u>}</u> : .			أرا		$\leq$		- \	<u>. L</u>	- \	7.	77	77	\ <u>.</u>		وادز			, <u>1</u> , .		:::="	Ŀ		٠	<u> </u>		1137	<u> </u>	<u> </u>			!
ţ-	į	۔ - د	.i .i			. ,	$\leq$	. ::			\·	( :)	<i>[</i> .\	1						17	Υ.	: 2				<u>: :</u>	- : 		.:	IJ÷.	i . i : 	7 - 5.	- 1	<u>.</u> :	ا لــــ
1	1 7			ļ				<i>)</i>		. `		<u>, '</u>	·;/	1.		\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \		ار ارسا	مربب		17	$\tilde{D}_{A}^{-}$ .		F .:	<u></u> ;		<u>:-</u> [];		[:.] Cia	: 11	'   <del> </del>	D	L		زء
	5-000E-0	, [	Ī		i .		-			<u></u>		7.7	Σ.;.	Z	7		-		ربز	المبنوا		/	٠ <u>.</u> '	ΞĒ	=;:	<b>:::</b>		- U	r :	14.	5	22-	ונים לורחל	- ፲፱፻፫፻ በነ	ŢŢ. i
	1	ή	<del> </del>	に	<u> </u>			:: .	- 1	· ::		12.7	- 2K	-					200		جرم	حرجة ا	= X	7	12-1				<u>.</u> :		Γέ.	918	,	<u></u>	
` <del>-:- </del>	<del>\                                    </del>	+	+7				abla			; >		122	·	7	155		7		ببنيا				متتر	,	:1::	1.5	- II	, ,	Д. Д.::	jr.	/B1		476	-C1	_
÷	·	<del>- -</del> -					-/-			1		1.5	-1/-	- 1		جـ	- 1	-/- /	بسرن سرن	7	1117	<u> </u>	.,.	. \	===	<u> </u>	- <u>- 7 F 1</u>	:		1111	<u>:</u> .	1030	1036		- i
<del></del>		+-,	<del>(  ·</del>	<del> </del>	<u> </u>	ļ	1			<u>.</u>	٠ <u>٠</u> ,	<u>, , , , , , , , , , , , , , , , , , , </u>		<u></u>	-	<u></u>	زر	 X:-	/ <u>:</u>		/	11		7		12., 23. 51			몿	: -1";	131	<del>]                                    </del>	1117	÷cb	~
		1.1	-17 <sup>-</sup> -	<u>  .</u>		ļ	<u> </u>	يصنا			٠;٠	; ;	12	-			<u>. ب</u>		1		1-	===									:::	ЗĘЕ	119#	±CC.	<u> </u>
: <u> </u> -	5 5305-0	<u>։</u> 	1	<u> </u>	: .	<u> </u>	::::		- : :	1.	).:				<u>.</u>	:-	7		ġ.;;	::::		111	/-	:	±4.	<u>:                                    </u>	<u></u>	- 1	\$1	1	1:1	53	1278	.÷cb	
	<u> </u>		]./	j		1 {				- 4	:::	<u>!:``</u>			[ i ]	-:-	1	:	. :	-7/	15	يرر		`:		7.1.	:15		Xii			7GE	1358	÷UU	{
E∯		. il. ·	· .		:		نر:	_ <u>:::</u>	::::	::::::::::::::::::::::::::::::::::::::	, <u>; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ;</u>		7		<i>y</i> :-	<u>:</u> : ز	<i>‡</i> .	: ,-		7.		7:		::::	曲	ii:	'n,	1::1		ijΈ			343E	יוטיי. ממני	_
. ليد	<u>.</u>	F	-	1			٠.	١.	: .	<u>, , , , , , , , , , , , , , , , , , , </u>	T	-;;:	1	1	1;		:,: '/		7.55	TE		:	:			;; <u>;</u>		1.11	511	Ţ.		10.T.	159	-170	
· <del>ह</del> ि:	1- 1-	-	1	1	ļ. —	: .	-:.:	7:	7	** ,:	<i>j</i> :	::::		1111	7	<u>: ::</u>	::/	. :	ř.	- 1-		= -	- ·	. ::	:h::	:		1 ::	密甘	Ήį	<u>:</u> E:	360	1678	.+ûÜ	-
<u></u>	2.3002-0			i	<u>-</u>	<u>.                                    </u>	. ;.							١.,			::}	1	::. ::::	:::	-	-1.		:	1.5				XI.		īa:	55		.∸GD	
[44]		-1;	- <del>i</del>	-	<del>. :</del>			7		17		:1:;	1.	1.1	7,11	) i	1 1			if E	1:-		71.	1:	-14			1	ķri:	F	12	720	1856	. <b>-</b> uþ	
<u>- ‡</u> -	<del>         </del>	+	11	<u>                                     </u>	<del></del> -				1 111	) <u>.                                    </u>		1	115	1/	1 214	1171 711	1:	<del> </del>		;;-	,		-		7.	4	1: ;;	117	11 11			966	190	<del>[+U[</del>	
	1"1-		<u> </u>	<b> </b> -			1111			3			-				- 7	122	122-	  -  -		7 ===		1111		.:t1 !==.					13.	ÇŞ	99	<del> +</del>	<del>.</del>
	<u>:::1</u>	-	<u>:i\.</u> :	1:-	"		• • •		117	17:5		ijij	17	<u> :::</u>	17:-	1:4	7:	:::		1111	===	:=:	1===	::/.	<u> </u>		***	1 1	1147	1111	13	. <u>22</u> 1	3068	<u>ااثا+.</u> طورت	<del></del>
<u>. L.</u>	.:   ; 	<u>. ان</u>	1.7	Ŀ		<u> </u>		J.		::::	::·	цΕ		<u> </u>	121	::		1	i El	些				/ ::		===	<u>:</u>		411	聞		156 156	1140	.+UU	<u></u> ,
-:	D CUGE	Ή	<u> </u>	<u></u>	<u>  ""   </u>	<u> </u>	<u> </u>	: 1:1	<u> </u>	17.	11.5	F.	. i -	-	<u>'</u>			1.		1,12	=	=		·- :	-11	**::	•	1:1	<u>                                      </u>	34:	3.	77	130	- <del>-    </del>	<u>.</u> ;
	1		1.	ŀ	<u>}</u>	.i.:	:		===	;;;;;	1:4	=:		\'	<u>;;;</u>	تا	7:		:	. <u>::</u> :	H	ر. - برز	<u>.</u>		1111	<u> </u>									끏
*:.l	. :	•   •	7:7	1	===	ν,	::::	;; ·	:::::	įĿ:	:{:	1,	171.		1	11,5	#12	::::		- 1=	1	.::.	: :-	- :	1	i.;	4:1	<u>-:-</u> !	li:¦i	H	ļ	1	.	.: [	
7	1 .	=	<del> </del>	1	1	.:	1	,	7.	7		<u> </u>			==	- 1		11.	1. ;	7				Fr		::			.11	.;	111	];		-1	
,- <u></u>				1:	<del>! : .</del>	<del> -</del>	<u>                                     </u>	- <del></del>	. 4:			. 7	\ <u> </u>	<del> </del>	r:	7.1		-						155.		;·:	:-4	12.	<u>.n</u>  :::.	11	i:i.	<u>    </u> 	. ,	- j.	]
	1 5005 1		. <u></u>	<del> </del>	<del>.</del>	<u>_</u>		ļ- <u>-</u> -		4			1	<b>-</b>	-	-	=	4	<u> </u>	-:-		77.	<u> </u> -			<del>,</del>		<u> </u>	1.7		†==	7	† <u>-</u>	, ,	
<del>-</del>	<del>- </del>	- 1  GG		+		£574	₹~∰		<del>  -</del>	14			_	1	F	<u>.</u>	77.	34/	) <del>, -</del> c	): } }	1 Çî	(50	<u> </u>	-		<u>ē</u> cæ	-GE	<del>  :</del>	1.5	111	17.0	<del>                                   </del>		-	أث. ا
	++		<u>.                                    </u>	<u> </u> :	T=	<b>.</b>	<del>φ3</del> 5	72		1::	14	بان	L	ĮŶĹ		<u> P:::</u>	-	ļ	<del>* - :</del>	빈.	<u>IXE</u>	Vo	<del>]</del> -					-			<del> </del>	-	<del> </del>		
	. !	: !	i	<u> </u>	ļ	ļ	<u>.</u>	<u>:</u> `			نئإ	=		<u>ļ</u>	<u>r :</u>	<u> </u>	-1: -:		[- :	-	<u> </u>	===	<u> </u>	<u>                                     </u>	- :-			}- <u>-</u> -	1.11	1:	<u>::::</u> :	15.		ļ·	
	1 :	1			1:	-	· .	Ì	<u>.</u>	] :	<u>;.</u>	1	<u>: :</u> :	<u> : .</u>	<u>i:</u>	<u></u>	1	: ::		· :		<u> </u>		L.	<u>: :</u>		L_	<u>  · </u>	1.	<u>:</u>	ļ:'':	<u>                                     </u>		1.3	!
		-	,	.[	- :		<u>  : :</u>			ļ, <sup>-</sup>	- :-		<b>[:</b> :		. =		_::		i - '	<u> </u>	1.	<u>  :</u>	<u>}</u>	_:	: `			. 	ļ. i	<u> </u>	Ĺ	<u> </u>	ļ.,		
77.327	<del>-</del> <del>-</del>	- [	1,	1		-	<b>!</b>	  -:	: 1	Ē	]: <u>:</u> :	FI	(	F	RI	- -	18	į	-  -  -	1.:	<u></u>	ĺ.	Ϊ.,	ļ.:: <u>:</u>	; . :		 :.	.		ļ:.:.	lii:	1:		1	
~	- <u>-</u>	<del> </del>		1 :	1		1	<u> </u>		F. :	- :-	-!		1	RI	·		1	<u> </u>	1		: : : :,!		1.15			, ,	1	<u>:</u> :	::;	<u> </u>			]	:
i	<u> </u>				<u> </u>	<del> </del>	<u> </u> -	:·,		1				<u> -</u>	Ï	1	,	H	<b> </b>	1	†:::	1:	i	<u>l:::</u> :		<u> </u>	<u> </u>	†-:		Ħ.		-	 !	[ <u>;</u> ·	
•	: :	. !	İ	1		32	i	1	1:::	ι.	1		1.	4-	1	1	1 :	T .	1 :	j ~ .	1	1	i	1 : :		1		1 :	1, 11	11.	1	ــــــــــــــــــــــــــــــــــــــ	<u> </u>		







### B. Energy Release in a Fluid with Finite Amplitude Waves, Simple Energy Source

We have carried out to completion the calculation started in the second quarterly report and described on page 26 of that report.

The calculation consists of adding an energy source term to the energy equation. There is no associated mass source term in the continuity equation. The energy term is dependent on the local pressure via

$$\dot{E} = \text{const} | (p-1) |^{\nu} \cdot \mu$$
,  $\nu = \frac{1}{2} \text{ if } p < 1$ 
 $\nu = 1 \text{ otherwise}$ 

It is also assumed that a velocity effect can be included by allowing  $\mu$  to depend on the magnitude of the velocity  $|\vec{u}\,|\,=\,(u^2+v^2)^{\frac{1}{2}\cdot}$  via

$$\mu \, = \, 1 \quad \text{if} \ \left| \vec{u} \, \right| \, \geq \, \delta$$

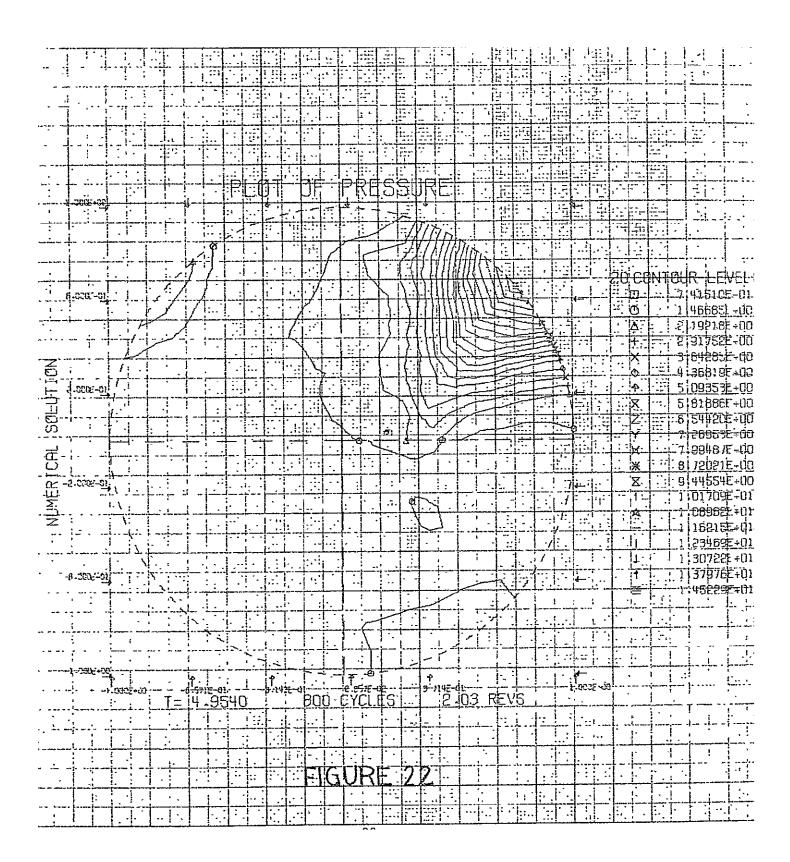
 $\mu = 0$  otherwise

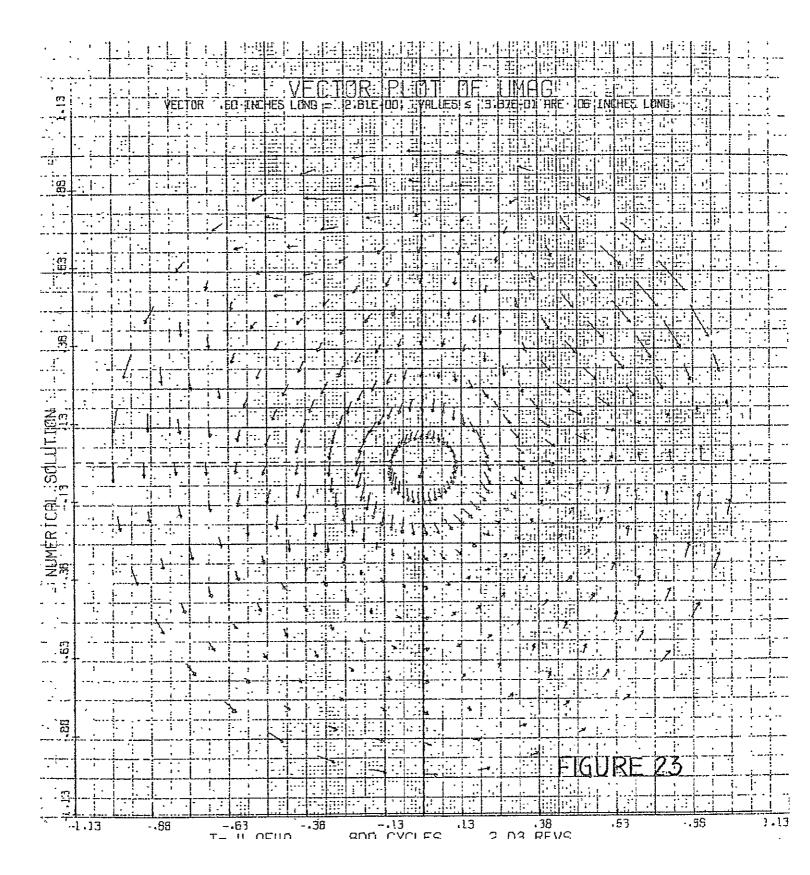
We chose  $\delta$  to be large enough so that the energy release occurred within the region of the pressure wave and nowhere else.

Finally, with the experience gained with the calculation described in section E of the second quarterly, we turn on the energy source slowly, i.e., the actual term used in the difference equation is  $\omega E$  where  $\omega$  is monitonically increasing and satisfies  $0 \le \omega \le 1$ . We take  $\omega$  to be the value of the 'rev' counter during the first rotation of the wave, it is taken as unity for all subsequent rotations.

The calculation starts off exactly as in the last section. Figures 22 and 23 show the extent of the development of the wave after about 1.8 rotations of the wave (note the velocity vector

at r=0, the rev counter, has just passed the starting position  $\theta=-\pi/2$  for the second time) and it is clear that the structure is quite similar to the non-reactive case. However, the peak pressure is 4350 psia. The velocity field is also similar to the non-reactive case. The maximum velocity in the wave corresponds to 9800 ft/sec. Of course, as the calculation proceeds, the pressure amplitude continues to grow reaching a value approximately thirty times the reference pressure while the maximum velocity reaches a value six times the reference sound speed after just four hundred more cycles of calculation.





## Energy Release in a Fluid with Finite Amplitude Waves (Including the Axial Flux Calculation)

It is clear from the last section that unless energy is allowed to leave the system convectively, the pressure (as well as the specific internal energy) will continue to increase monotonically. Program COMB was then modified to include, in an approximate way, a value for the axial flux of energy.

Several approximations were tried. The first method, and perhaps the most obvious, involved in essentially finding the total energy (and mass) contained in the  $r-\theta$  plane for each cycle of computation. The excess due to accumulation is parceled equally so that at each mesh point there exists a contribution to outflow which will exceed the inflow by just the amount that is accumulated. It was found that this procedure seems to work for small amplitude waves where only slight spatial variations in the energy release However, for finite amplitude waves which initiate locally large influxes of mass and energy (due to increased transport processes on the droplet spray) this procedure fails to work. regions of the flow field where little reaction occurs see, according to this procedure, a relatively large outflow of energy (or mass). If this occurs for a sufficient number of time steps, the flow pressure (or density) can become negative locally and indeed this has been our observation. It is clear that a weighting of the outflow according to the inflow would be more desirable.

This was done for the simple energy release model given in the last section; the results being given below. The energy that was input due to combustion was allowed to reside in the r,  $\theta$ 

plane for one time step and then it was immediately considered to contribute to the axial flux. The following table gives a quick comparison of the value of  $p_{\text{max}}/\gamma p_{\infty}$  of three calculations. The first column is an inert calculation with no energy term, the second with the simple energy model including an energy flux in the axial direction, and finally the third calculation is with the simple energy model but no convective flux in the z direction, i.e., the energy is locked in.

Wave Amplitude  $(P_{\text{max}}/\gamma P_{\infty})$ 

Cycle	Inert Case	With Axial Flux	Trapped Case
0	1.63	1.63	1.63
600	3.25	3.73	7.18
1000	3.21	3.53	19.57
1200	3.05	3.45	29.65
1400	2.84	3.91	

The final row of data corresponds to approximately 3.27 rotations of the wave and it is clear that by including the axial flux, the rapid growth of the wave is controlled while the energy source itself supplies energy to the wave.

It was found that for values of ten times the constant in the energy law in section B, the solution could not be continued beyond 300 cycles. This value is consistent with a physically real energy release near the injector. It is clear that the evaluation of the axial flux is quite critical and indeed, the problem really requires a third dimension so as to mathematically pose the calculation correctly.

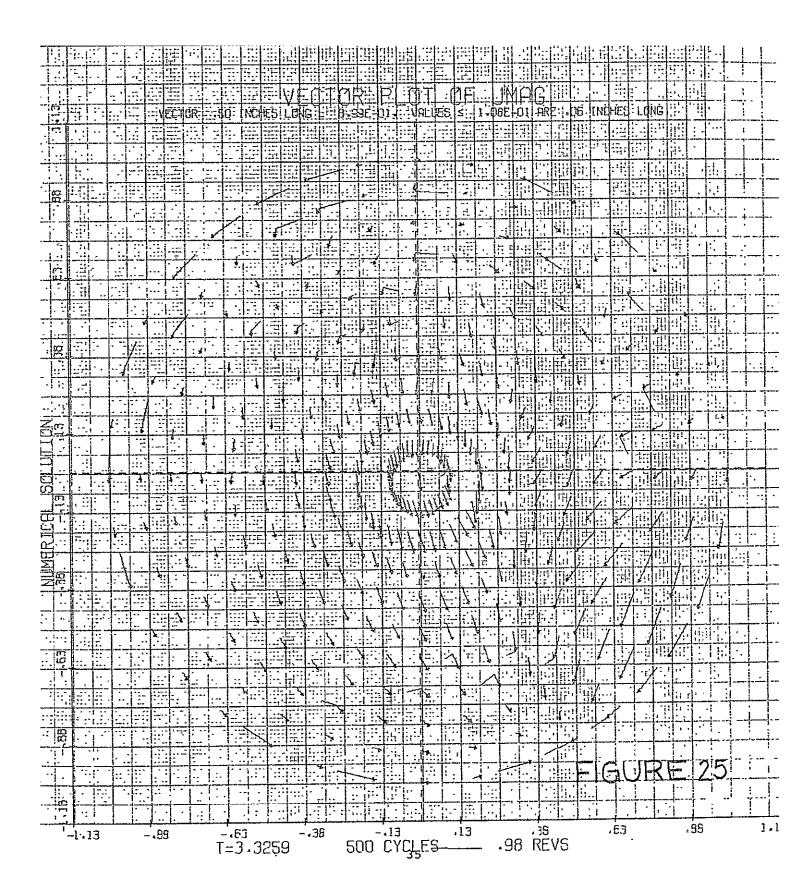
# D. Finite Amplitude Waves and Simplified Modified Godsave Analysis

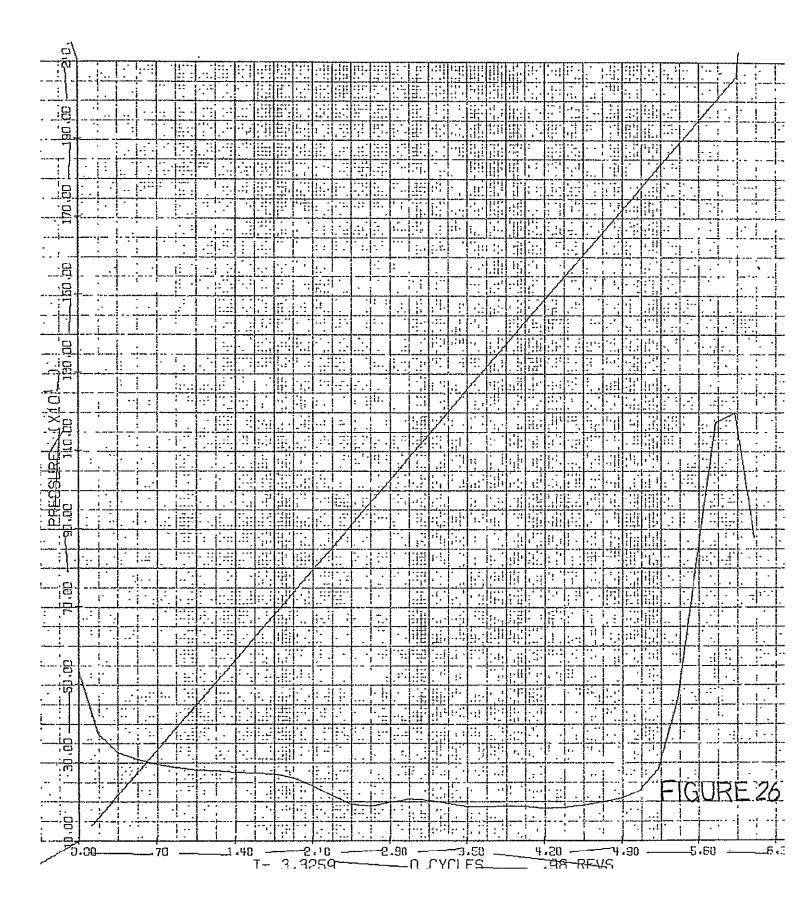
In this section we show the results of a tangential pressure wave interacting with a system of droplets (mean diameter =  $75\mu$ ) which evaporates and burns according to the simplified Godsave analysis presented in Section II of this report. Hence, there is both an energy source for the energy equation as well as a mass source included in the continuity equation. However, there is no axial flux calculation included in this section.

. The calculation consisted in specifying the flow field at t = 0. It is similiar to that given in figures 1 and 2 except that the maximum (minimum) pressure is 550 psia (50 psia). The calculation proceeds without energy addition for as long as it takes the wave to make one complete rotation. Then the calculation incorporates the relations developed in Section II of this report for the evaporation and combustion of the droplets. The energy and mass source is turned on completely just as the-wave is starting its second period of rotation. Figures 24 and 25 give the fluid dynamic field just before the droplets start interacting (excuse the extraneous hash for this series of pictures which is due to a malfunctioning solenoid valve hooked onto the pen on the Calcomp Plotter). For this series of pictures the pressure is normalized with  $p_{\infty}$  (rather than  $\gamma p_{\infty}$  as before). Figure 26 gives the dimensional pressure  $p(R,\theta)$  at t = 3.3259 units at the outer wall of the chamber (r = R), again just before the energy is switched on. The wave is moving from right to left.

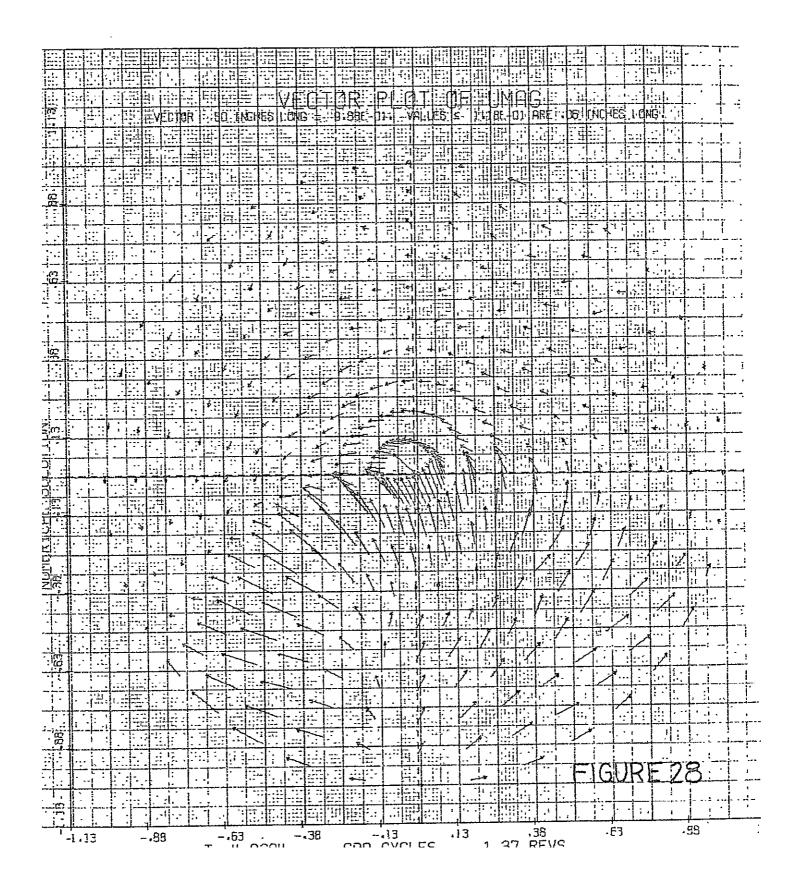
The next two figures, 27 and 28, show the initial transient as the energy is switched on. Due to large radial components, figure 28, the pressure pulse moves inward, but still undergoing rotation as the next four figures indicate (figures 29-32). The next sequence of figures (figures 33-38) show the transition to the compression/rarefaction pulse traveling along the chamber wall (except that strong radial motion flattens the pulse against the wall). This is seen from figure 39 to the final figure 44. As can be seen from figures 28 and 30, strong radial motion is generated by the large release of energy and persists as transverse motion is interacting with the tangential motion. The resultant 'steady' or time periodic pattern would require additional calculation.

1 426 4 12	I TEN		1 .:.	. :-1	[':;]	:;.·1	.,!.;	:=:1	71.4	<u>:</u>	::.		<b>1</b> 4° ₁ 1	::1	;	1	- 1	H <sub>1</sub> H	!:: 1	٠.,	۱،،،ٔ	,	<u>.</u> .,	  • ••	ļ	ı	· .	ا بر	1	
	1-4		4.::					::::		<del></del>		.":	# ! -				-1,		-:  -:		:i	<del>. :</del>		<u>-</u>	<u> </u> .	ļ	L	ــ ئــنــــــــــــــــــــــــــــــــ	- <del>  .</del>	
	1:1=		1 -:	-; :	1				:-:		<u>:</u> -	***	Ĺ:			13-11		i : i	11:51	<del>-:- </del>			-;;			<del>-</del> -		<u> </u>	ļ	<u>.</u>
	11		ļ.;	<u>::</u> ;	Œ	<u>i i i</u>	1.	1.4	`:::	i:-							2-6					44.	1				L	·:	-   :_	1 
		<u> </u> :-	* ::	:!::r		- : :		==	-			=::	3.7		:-	· · ·	·ři	1		أثب	ان	.				:		• ;		1.
	j. j.				# 1			- :	₹,:	<u> </u>	<u> </u>	١.	7.	٠.٠	٠.	7	:::-	<b>:</b>	::	·::	•	·	· <del>-</del>		i'-u L	_ ;		1	i.	<u>;</u>
	. · - i.		· [.·	:::	ii:	<u> </u>		::	:::	- :	:		÷. ·	:	.:.		·: 1.	=[.,		. ,	٠٠ ,		:::	;	!		1	1.		•
1			-				-				<u> </u>					- 1							•		;; <i>.</i>	.::			¬ }	
		<del></del>	<del></del>	-		] [	7	<b>3</b> F			ŻĖ	5	<b>3</b> 6	肰	7		;	; ·	- 1-			<u></u>	-	-	=	<u>                                     </u>			;	ž
11001-01			1	::	-	٠		ا جو		<u> </u>	==		1	7			-î	-	•••				-		<del></del>	-			1	· · · · · ·
	<del>+</del>	. <del></del> .	<u>.</u>			ر بر بر ا		:	:- :::	·-		- <u>-</u>		$\star$				<u>-</u>		7				-7	-	<u> </u>		<del>-</del> -	• [	·
	<del></del>		<u>ئىر</u>		"			_	:-		4	<del> </del>	/			5 ·	1.	-1		Z.,			<u> </u>		<del>  · ·</del>	-	i 	ļ Ļ.		. بيرميد
	. ļ <u>.</u> .	کے لیا۔۔	·	<u>ابند</u>		i			7		<u>\</u>		1/	,		· · ·			Ζ.,	<u> </u>					ļ ·	Ĺ		- أبـــا		
	1.1	1	·:	:::	<u> </u>	- :	: '	:::	Ξ	<u>)</u>	. :	$L_{L}$	/ <del>-</del> :	$\cdot$	7.	::4;	٠.,	X	-:	.::		• •		70	c	TA	ØU	R.L	<u> </u>	1.5
[20-2000-3	14	-	عمل						. ,	_		Įχ	ł		/		$\angle$		$\leq$	<u> j</u>	, ,		.,	F:.			5.	825	2 <del>1.</del> -1	<u> </u>
	7	-		1		::	- 1	٠٠٠		::::		(-  -	Ž	; .	=,	V	- 1	ı ŗ	٦;:		:;	;	:::	:-	سوا	-	7.	6261	1 EI	ונ בנ
	1: 1	1	7.:			, .	7	- :	:·	::	Z	<u>.</u>	i. Y		/			rii	Ξ.	Ţ.	- ;	Ē+;-			Δ.:		9	4223	<del>- }</del> -	]]
	1:	<del>[ ]</del>	<u> </u>	2.	1772	fi,		\ \	2 4	7			<u> </u> \	7		. \	•	- <del> </del>  -		:::\	٠.		i;.	÷.	1	1	Ţ.,	1510	軒	ъ, –
	1-1	<del></del>	1	. :		H I	ــــــــــــــــــــــــــــــــــــــ	٠		7	ļ_	<del>  [</del>	17	۲۲:		, ,		-	· · ·	7:	<b>\</b>		-	<del>                                     </del>	}₹= (	1	<u>-</u>	3011	6E-1	<del>10</del> -
	·-  -	-i-	<u> </u>	- 1	1-:-	 		::	: 7	-	<del>  \</del>	1	); y	··- <u>·</u>			<u> </u>	1:-	<u> </u>	11.7			<del>                                     </del>		<u> </u>			4811		20.
# 8-0001-01	+		1.	:	-:-:	<del>-</del>			:/	<u>.                                    </u>	-	<u> </u>	<u>  []</u>	<u> </u>	<u>}</u> -				· ;	کر	; }	7				-	<u></u>	(6607 (8403	3£+1 8:33	100 100
3-4			<u>  :::</u>					· ,	<i>!</i> · ·	-	<u>/_</u>	1.	ļ ~				7			انزر	ا سر	]	- 	<u> </u>	χ. Ζ.	1.577	-2	1 1		יטי. חחז ר
<i>σ</i> ://	-		ĺ,		1-12	1.		/		<i>/</i>	<u></u>	1	الري		1	-:	7	<u> </u>		سنز	منه		<u>.                                    </u>			ļ	<u> </u>	<del>199</del> 6	Ω¶- -	90-
# !/ h []		T	-		, :	ii'		ζ.	/	.; .	<u> </u>	C	17	ĽĽ			-	12				]. •	<u>:</u> :		ж.	<u> </u>		1796 1792 5565	3[-	ф.
9 7		7	1:.:		: :	Ή,	-/	X			- ا	- 9	1	1.1	F{-\	::.	سبنا	1				ţ	į	Ι.	ж.	-  -	2.	5566	5 d. ±1	סט
<u>n-ricoti-ni</u>			1	7	:-;.	· .:;	1/	• •			<u> </u>	<del>21</del>  -	1.	1	()	17	1	17	[]]	17.1	17		ļ .	, ;	× '-	. :	2.	7384	75+1	כם
불 : / : : : :	1	<u>-</u> † -	<u> </u>			Z	: \				: .	13	[:]	1	11			7	///		[J]:				1		12	3151	먁	CC.
NUMERI CO		:	+-		:	<i>/</i>	•	7.	. :	:::	1::-	+	<del>                                     </del>		1.	Ηt	1.	1	Ή	$\mathbf{K}$		+	<del>- :</del>		147	-	1.3	10977	=-	9B-
-1-17-1-1	-		+		7	1		- ;				17	1:3	-	1:	4	1	1	1/7		<u> </u>	-	j	-7		ŁΞ	큳	12 Jr 13 14569		. <u></u>
		<u>:: :</u> _	Ļ		/_		<u> </u>	1	7			1	1.3		7	7.7	4	4	4	汉	12:1	<b>.</b>	<u> </u>	=-}	╠╧	-	7	6365		UL' Tiri
- Free Picker Plan	<u>\!:i</u>	.   _	*	-	•••	===	-	: +	: \	<u> </u>	<u> </u>		يخ	7	: , `			1/7	7.7.	£ .		, <u> </u>	<u>!</u> :	2: :	<del> </del>	<u>:</u> :	) 	3166		 
	: <u>  `` \                                </u>	· <i>X</i> .	<u> -</u>	/.	•				٠.		<u>L':</u>	<u> </u>	$\Gamma_{s}$	$\leq$		7	7	7	χi	.::	- 11	-	! 4	Ŀ		-	17	1000	┷┦╴ ┖┼ <u>┡</u> ╌	<u>.</u>
	1. >	₹ !: "	1:/	]	-	Ti		: ::		<u> </u>		4.	į .			E.	1	×	<u> </u>				<u></u>	1. :	E:	-	<u>  .                                     </u>	<u>                                     </u>	_ _	Ŀ
7 1		!	<u>JZ:</u>	·;	<u> </u>		1.7	11:	7;	: :	ļ ;; <sup>2</sup>	·	1	Z.	į		ر <u>ال</u> ا	1::			,	. ' '	١.	'	1 ::		1.:	1	<b>!</b> .	ŀ
1/- 1/		· - /	1		::-	: -;	٠.:	.:,1	.:.		<u> </u>	1	-		8	~			ļ. 	,	i.il	. ,	ţ —;	1	1.	.,,	1.	1 .:	T	+
	7.7	1				: - - - - - - -	:	·: <u>;</u> 1	=-  ::	:	†	1	] =	-1	0				1				<del> </del> 	]	<del> </del>	: ,	i		<u> </u>	T
-1 cont-iz		-{:-	<del> -</del>			<u></u>	5-81 5-5			75"	<del> </del>	1:-	1-	·4·	\ <del></del>			, .				igoos j≂.	:	<del> </del>	<del>  -</del>	<u> </u>	:	<u></u>		<del> -</del>
	1	-6 52	12-11	-		-143	5-01	77		1	E =12	<u>-</u>		3.71	HE-I	38 38	<u>                                     </u>	170	$\equiv$		- 1	ÇCC	:00.	بــــا	<del> </del>	-		<u> </u>   -	-	1
	1	= p -	Jei	9.	<u> ا</u>		. <del>.</del> .	uu	ا ًا	I.C	L.C	P.		<u> </u>	1	,	114E	V C	-					<u></u>	<u></u>	<del> </del> -	<u>! '</u>	<del> </del> -	<u>-</u> -	╁.
	1 2. ! .		1	1	7.	<u>                                      </u>	1 1 · .	13. <u>1</u>	<u> </u>	L:	<u> </u> :	<u> </u>	1:	<u>-</u> -	ļ	<u> </u>	=-	ļ	نين				ļ	ļ :.	ļ	<u></u>	<u> </u>	<u> </u>	}	
	. :			<u>`</u> ,		<u>.</u> `		.:	<u> </u>	Ŀ			<u> </u>	<u>L_</u>		1:	<u> </u>		<u>.</u> 1				<u> </u>			<u>.</u>	<u>L</u>	ļ	_	_J_
	•	T	i			3.5				1	: :	-				-		1							!	.	1		j	- •
	77	1	·-!		-		i –	二	C	1	JE	₹E	١.	2	1	1	-			1.		Γ					Ĭ		-;	
									  ->-		:	.X.L.	;	-	4		<u>.                                    </u>		<del>-</del> -				:	1	<del>                                     </del>	<b>T</b>		† " !	ï.	- ~ -
			·			  ::		<b> </b> -				<del>-</del> -	<del>†</del>		<del></del> -	f		j.			:	1	ļ .	+-	; -		<del>-</del>			. •
				<u>ان ا</u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u>! • </u>	1	<u>' ·</u>	<u></u>	<u> </u>	<u> </u>	<u></u>	<u>i:</u>		<u>L.</u>	:	<u>:</u> .	L	<u> </u>	<u>:</u>	.i	1	ننل	1	<u> </u>	i	, <b>.</b>

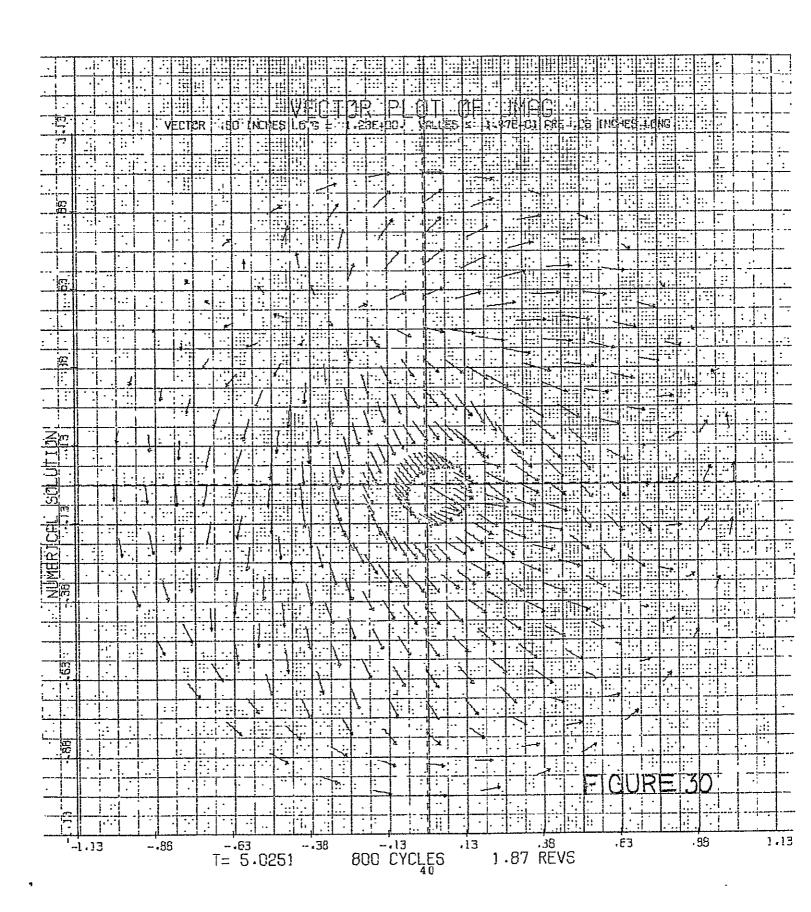


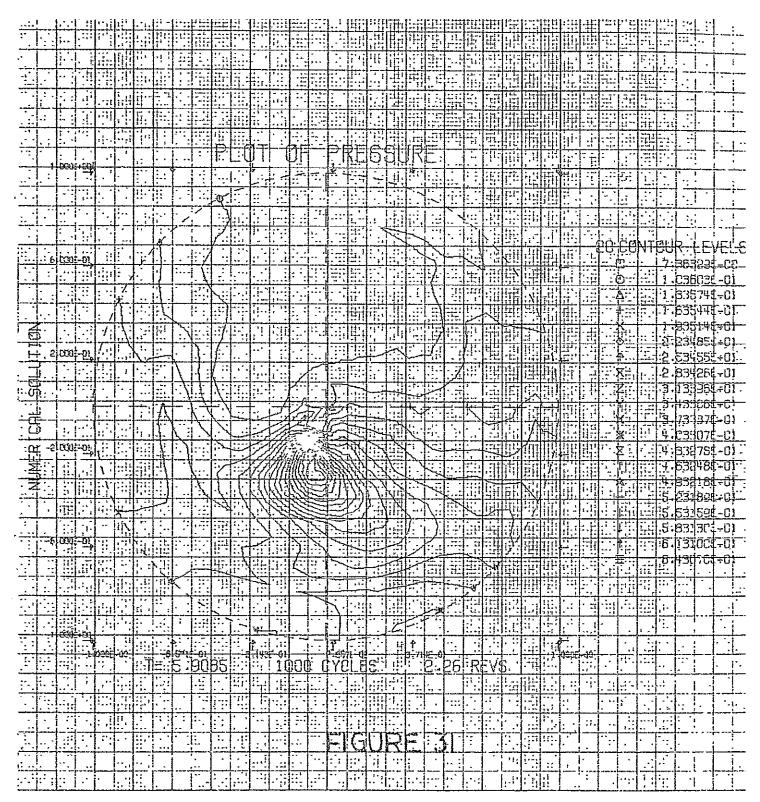


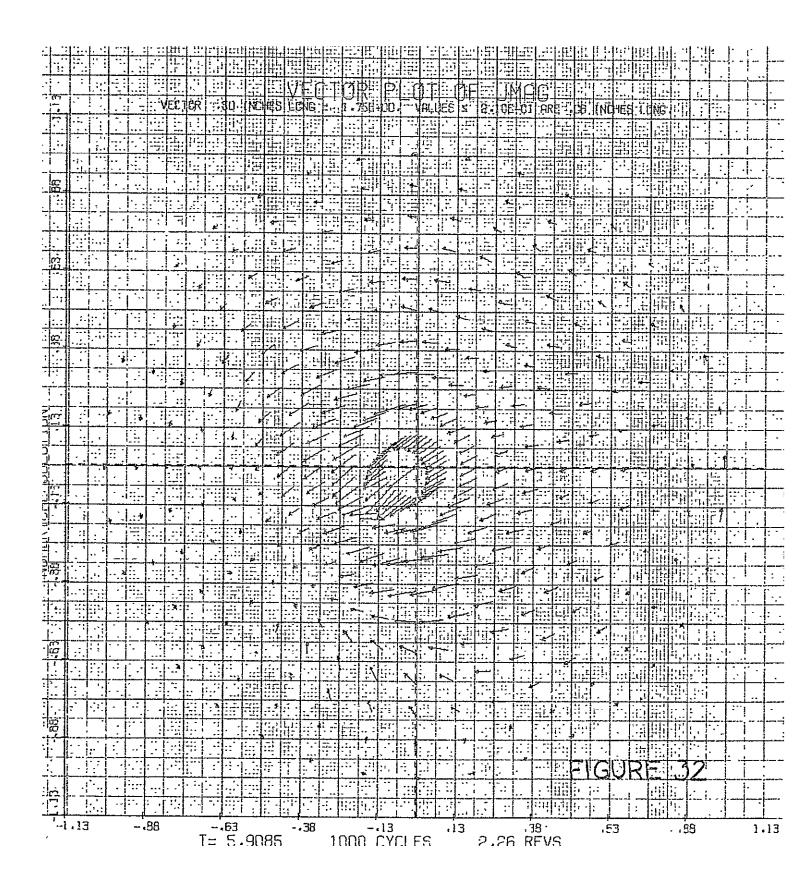
COL-10									1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				F .				1.	;;;; ***; :::::::::::::::::::::::::::::						127		::							
COL: 6													F :				1.	:::::::::::::::::::::::::::::::::::::::	111	1.1		- (! - (! - (!	<u></u>	:		<u>:</u>	-:-	;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;		;;; ;;			
COL: 6						7.					::::				127	1	<u>,:                                    </u>	:: /	: ;;;	1 1.	B:	: 1		: .			::			] .:]			
COL: 6									i		11.1 12.1					::										f	-1-1	-11	•	- [			
COI 0										1.	<u>.</u> ;	1	-	111			- 1		-:		Ę.,,	::-	77.3		. 1			iti-l	- 1		<u> </u>	-+	
CO# -0									<u></u>	; ; . ; .	 		<u></u>			H		.;			:1=	1 2 1	<u>.</u>	1	- :		7111			. 1	;		<del></del> -
COE-0						 22		::	; ; ;	<u>-</u>	1					ĦĦ	: -		-	-:	剒	7	-	-7-	. 2	-1:1	Ŧ		∷		7		
COS 0							P	<u>لر ::</u>	:	1	• • • • • •		• :.	; ;	· · ·	fir:		: 1	:\ ::-	:	<u> </u>	<u> </u>		;; :	1::		::-				<u></u> i	;	
COL-0			- 1: - 1: - 1:						H		기를		Ðİ	<b>7</b>	e	₹1	HÞ.	ĘŦ.						$\vdots$		i i			-			·Ļ	
COE-0		*:	-  -	-	1		<del>! :  </del>	<u> </u>	1:1	(, 1	ا الد ا		1	V L.		٠,٠	4		_ !		7			(	<u>  </u>		::::	1111	<u> </u>				:-
COR-0	1	-:	<u>  -</u>		· <del>[</del>				<u>;;.:</u> j		-: .:					- [ _:;					ᆵ	<u> </u>				īl:	- : :	1:1	- <u>:</u> -	:-	:-:	- ;	
cod-o	1	!	i.		ا.		::<	: 12:	',			.:		74 1		٠٠,	1:7	$\leq$			-5					إقنا	-1					<del>,</del>	<del>.</del>
<u>cor-o</u>	<u>.</u>			· 1	إبر		· .	-	,				-		] 	•		-	- >	>				<u>-`</u>				<u>[ ]</u>	أحسنا				·
<u>cot-o</u>	P.		1:	<u> 1</u>			: 1		1	-	-	`. •••	· 	:	. :.	:.,		:==	=	ٺند	\: <u>-</u>	: ]	· : Ē	<u>, , , , , , , , , , , , , , , , , , , </u>		<u>[</u> ۔۔۔ <u>۔</u>	במב	CO	i.	DĖ.	- 1		<del>}}.</del> .L.c
: : :			1	,				,::\	<u>;</u>	; ;	٠.	:		1	: ::	1	<del>  ; ' :</del>	<u>.</u>		:::	1	\:\.	, -,	i - "	[			H.	, i	5.	051	-L-V 436	
	- <del></del>	, ,					: :	::::	i .		:	::	::;	]_7 ]:	.i::	;	;	ELE.	-::		$\mathbb{R}^{-1}$	<u>-``</u>		٠٠.	ا:،		•• (	5		-1	ຂັບຕໍ່	43¢ 40\$	ut)
. 1	-	7		1			ii	:	÷	.:	٠.	2	7 :	:	:	17.		;	.:		• i <u>:</u>	- "	:\		: :.	-11	31:	Δ	:. ]	1.6	895	855	.÷ບີ່ປີ
		/-		- 1	-	,			<u>:</u>			·;.		1	,_	111	1:1		===		.:		\		-:-	- 1	7	F. ;		<u>;2.</u>	591	914	300
	17	<u>   </u>	T	:	1	::::	. ;.	7	71.	.: .	::15:	17.1	1	:	1	. 1-5:	14; 1	,	· . ::		I,	.:::	, ,	1	<del>,</del>	٠,	11, 1	ĵ	- ::	3.	200	16	:=₩7 08
 ח_בוות	<u>-                                    </u>	1		-			-		131						1				<del>'</del> —		7		7	<u> </u>	::,	,		2	,	-3- .ii	875 755	874 414	.≠⊌U- `∠n:n
	<del></del>	1:	1				-	-		1 :.	27.7	: i	1. :	<del>                                      </del>		11:-	1:		1.	سنز	٠,		<del>].</del> .			=	.:1.	<u></u>	Ĭ:	<u>'</u> 5:			
_	- {	<u> </u>	- 1:			<u> </u>			<del>-</del>		1 1.	1.1		1	<del> </del>		=-	٠٠٠	 ::	.,	· , ii	, !	/ <del>::</del> -	.,,1	1 1::-	:£	·	Ž.,.	- '-				
<u> </u>	- <u>H</u>						-	: '1	· ·				-	<u></u>					<u>.</u> .		.::1		- ·			-:::		¥		6.	762	438	<del>-:00-</del>
<del>-                                    </del>			<u> </u>	<u>::</u>	<del></del>	-	, r 12 ;	17 1	سنزا	سرا		سرسا سرور		مرير ل	泛		1					4		}		=			1	:7.	457	585	+09-
	<del>: } .</del>	.											ښا		1:		>>,	1	)_	}	<u> Z</u> :					<del>:-</del>			-:-				
::U::-!	- 1		٠- ا	-		: .	//				يننا	$\geq$	بنرا	$V_{V}$		أبسرا	رترا	7	<u>/:</u>	4			<u></u>	• }	-	17,		<u>X</u>			יונים ביוום	190	.#UU 그만인
	1.	1. [	- 1	==		-/	///			-		/		/			1/		<i>:/</i> :	L	::::		7::	: <u>F</u>	111					1	200	774 976	
<u> </u>	_  \	1 :: :	·			]	///		1		1/2		مرا	12.7	1.		K	<u>//</u>	\ <u>'</u>	,	. `	ΣΞ	<u>;/</u> .,	<i>::</i> :	1 : 1	17:1	1- 1		<u> </u>		59:	43	-+C]
·; ·;	1		1	=	]	1.1.1	H.	111	$\langle \gamma \rangle$	3		1		<i>/</i>	,,,	(; -i₁	$\mathbb{Z}$		1.	: ::	. : ;	1	7		i.,,		-	ļ ',	::.	<u>i</u> .	162	326	<u> +01</u>
		Ţ,	. ;	7	·J:	11)	////	///	سر	$I_{L}$	1//	);;f	ί.			1/2	<u>,</u> , ,	i;	1: \	٠.,		<u>:</u>	\$D.	:		٠.	<u>-</u>	1:	:				
::31E=!	到.	[4]		7	$T_{J}$		T/T	$\mathbb{Z}$	7.4	$\mathcal{H}$	II	N	V .	₹≅.	1	<b>[</b> []]	1::- )		: }	ļ	: =	·	; <del>;</del> ::	)	<b>.</b>				· i · .	111.	L. 15	أحيما	
			፣ኁ			///	111 is	()/,	7	ŢŦ	M	11,	//	X	1.7	1	[,/:		:-	H.:	:		:	·			<u> </u>	Ti:	Ξ.		د 7 <i>د</i>	OUG	×÷01
	Ţ	1		- 25		7/)	<i>†††,</i>	///		1	111	1/7	X	(1	[.]	[: -	1	1- :		-21			Ī.	ļ.	,	; · . ;	i		· ,	1	7	.	
- <del> </del> -	7	[.::				47	7//	#/;		口	<i>†††</i>	<i>(</i> †/	ĬĹ,	1	1:1	Ţ.::	Ţ <u>.</u>	] = ]	::	;; .	7	.:			:	-::		<u> </u> -	•	:::	=	[; ]	
						12:2	25/	4		1	<i>\\\</i>	TT	11	17	1	$\mathbb{T}$	<u>:</u> \;	ļ.,						†^^- !		; <b>-</b>	<u> </u>	1	-	ļ	•	[ -	<u> </u>
3 <del>006+</del>	<u>-  </u>	<del>-</del>				i ,	-	<del>                                     </del>	1		¦\∕\	47,	<del>  } }</del>	+3	+-	1	4	<del> </del>	-	<u>                                   </u>	-	<del> </del>		. 1				<del></del>	  .	<del>  -</del> -		<del>-</del>	ļ
	-1 hoé	E d :	<del>                                     </del>	6	57-5	-01,	nei		113	101	10	L:	137	<del>1</del> 9	<del> </del>	1.1.	7	<del>1€-0</del>	27	· D	- 110		<del></del>	1-1-	000E	-da-	<del> </del>		-	<u>  :-                                   </u>			-
<u>  -</u>	- ;	<u>. -</u> -	F	=	4	<u>UJ</u>	냙	···	1	-	<u> </u>	ابد	1. 1.	-1-	1*	٠	-	1	7/		V .	<u>u.                                    </u>	<u> </u>	<del> </del>		<del>  -</del>	<del>  -</del> -	+	-	<del>                                     </del>	<u> </u>		<del>-</del> -
	;- -÷	<del> </del>	<del>  1</del>				<del> </del>	//.	· · ·	<u> </u> -		1	ļ.,	1	·) · · . ·	ļ. ·	-	1	<u> </u>		J <i>:</i>	-تـــ	ļ. :	<u> </u>	<del> </del>	<del>`</del>	ļ - <u>-</u> :	<del>                                      </del>	<u> </u>	<del>  ;;</del>		}	<del> </del>  -
-	<u> -</u>	· · ··	1			<u></u>	//	ļ	<u>  : : : : : : : : : : : : : : : : : : :</u>	1			<u> </u>			ļ.			-	Ļ.	<u>L.</u>	<u>: :</u>	<u> </u>		ļ	!	<b>}</b>		t	<u> </u>			<u>-</u>
<u></u>	<u> </u> :	, <u>-</u>		·	<u> </u>	Ľ.	<u>  </u>	<u> </u>		1:	1		1:		1	1	ļ'	ĽŢ.	ļ.,	ļ- 	ļ <u>.</u> . :	! ;	-	ļ		<u> </u>		<u>-</u> -	ļ., ´	··	-: -	;!	-
<u> </u>	<u> </u>		<u>                                      </u>			<u>[. :</u>	:	<u> </u>		1:	Ħ.		زاإ	比	=		1			<u>L.</u>	<u> </u>		- '		 	<u> </u>	ļ		<u> </u>	<u> </u>	]		:
.:	<u>:</u>  :	- 1 - '	<u> </u>	_	. :	-'- 	:	<u>:</u> :	-			:	:		1	<u> </u>	Ľ	<u>  : :</u>	Ŀ	<u>  .</u>			<u> </u>	i			<u>L</u> .	ļ. 			ļ		
;		1	17			[·-	1::	<u> </u>	[·	1:	177	. 11	1:	.[ 7:]	. 177	Γ.	[]	1	"		1	۰		· -	1			İ.		1		• 3	
		100	CUZ-CI			CU2-01 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03 CU2-03	CO2-01	CO2-01 (1) (2) (2) (3) (4) (4) (4) (4) (4) (4) (4) (4) (4) (4	CUZ-0) (1) (1) (1) (1) (1) (1) (1) (1) (1) (1	CUZ-02 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03 // CUZ-03		CUZ-02 //	CUZ-02 /		CO2-0), (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01 7. COZ-01	CUZ-Q1, 7 (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	002-03,		COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-CG, (1)  COZ-C	COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, // COZ-CG, //	002-03	COL-03 /	COL-03, 1/2  COL-03, 1/2  COL-04, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-05, 1/2  COL-0	COZ-01 // COZ-02 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03 // COZ-03	COZ-01 // COZ-02 // COZ-03 // COZ-03 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04 // COZ-04	COZ-01	COZ-0, 7		005-00 /	COS-09 / 1	03-04	1 1 295655

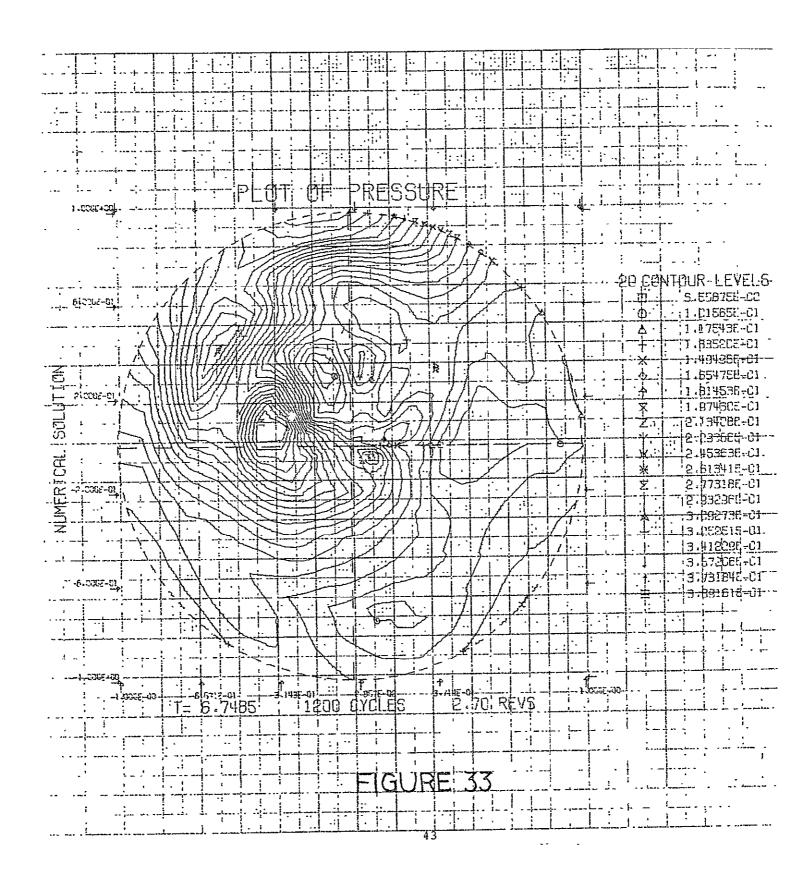


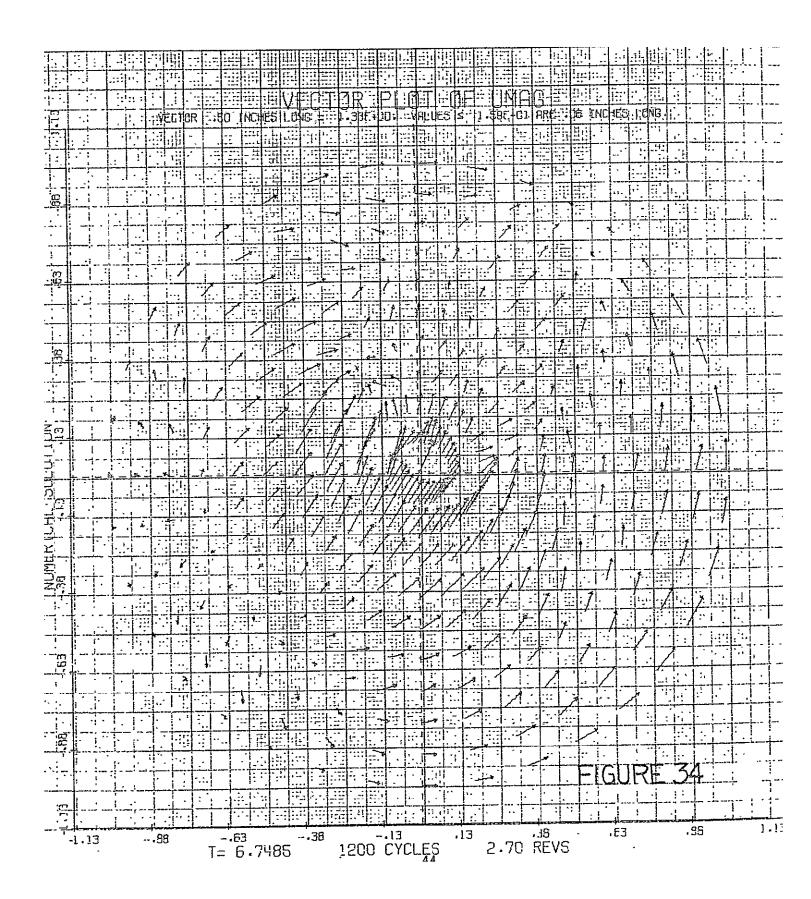
,							
					11:1 1:111		
	1000						
	1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.						
	1 11 11 1	1722 - 122					
	1 7 7 7	1 - 1 - 1 - 1					
			Ad bbi	eei le			
in the second	<u>į Fill.</u>	<u> </u>		100011	<u> :</u>		
	<u> </u>	1	增加指力		= - :		
	1:1:15					E-15-1 - 1-21 -	
	سزا بنشير	7					
		T 77	NACT N	TVVV			bolowitzib i ciri
5 2002-01				1.11.11	1 1 1 1 1 1		TO STANDERS AND THE PERSON
5 8306-61		<u>\                                    </u>		t Kitilitik			- 1:1:05 - 1:1:19:73503E-00
	tink	1111111111	HHILIKA	ELECTRICAL SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF THE SECTION OF	\(\frac{1-11}{1-11}		7 - FI - A I - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -
		X X X X X X				140 1 1 VI al-	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
		17/1/	HARAGE THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE OF THE STATE O		111111		1.435751+01 1.666915-01 1.998055+01
· 自由 · 自 · 自 · 自		17/1	VIII		11/41/1/2		1_898055+01-
2 0000		1-1-1			741114	그 때문의 '' 구학:	2,129194-01
		14年1年	イングへ		<b>MHI</b>		THE PERSON X - 1 1/5 (350) 352 +0
50 - 1 - 1 - 1	1 .  ::. }-	黑儿光		7.			- 1- T T 1- 1- 1- 1- 1- 1- 1- 1- 1- 1- 1- 1- 1
							2 52 100 - 01 - 01 - 01 - 01 - 01 - 01 - 01
4		1= 1 1					1
. Of -2 DEG(+D)	1 1	V				F-Fr 3F 57	:: -:: :
- 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	1						::
							" I TO THE TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL TOTAL T
					17:11 1 1 1:01	1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 militar   1 mili	4 203421+0)
	1 11 2 2 1			1 7 11 11	-	11 11 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	
				₩ <u></u>	<u>                                     </u>		. a 4 . 4 . 671698-Cl
6 000 (-0)	1 1 1 1 1 1	1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	- 1	:	· · // : ! ! !	11/2/1:1:1:	.
	<u> </u>			: : : : : : : : : : : : : : : : : : : :			
	上北十	1. 1. 1.		1	開車にと		
					30		
1000 00		9			1		
100000			600: CYCL				
1 1 10 BEEN 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	5.0251	144	BOO OYOL	曾是	1.87 R	V8.	cor ue
1,122,00	10-UCD		1000: U TUL	.40:12	1.127	1 1 2 2	
3. 1 3 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	<del>       </del>	-1 <del>1</del>	# **** "* " " " " " " " " " " " " " " "			21 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	
	: : :						
		der işder		JUKE	29	.: ": [: ] : [	1
	1				]:-		
	] : [,4]:	:::::::::::::::::::::::::::::::::::::::		14 1, 44 11			
<u> </u>	<del></del>			30	<del> </del>	<del>, , , , , , , , , , , , , , , , , , , </del>	



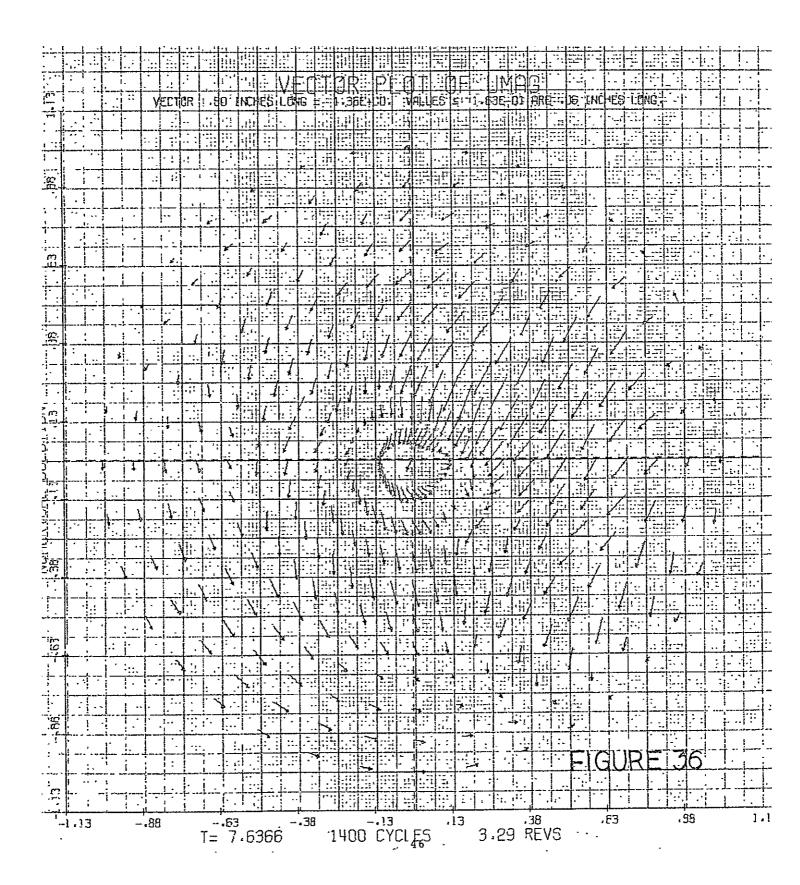




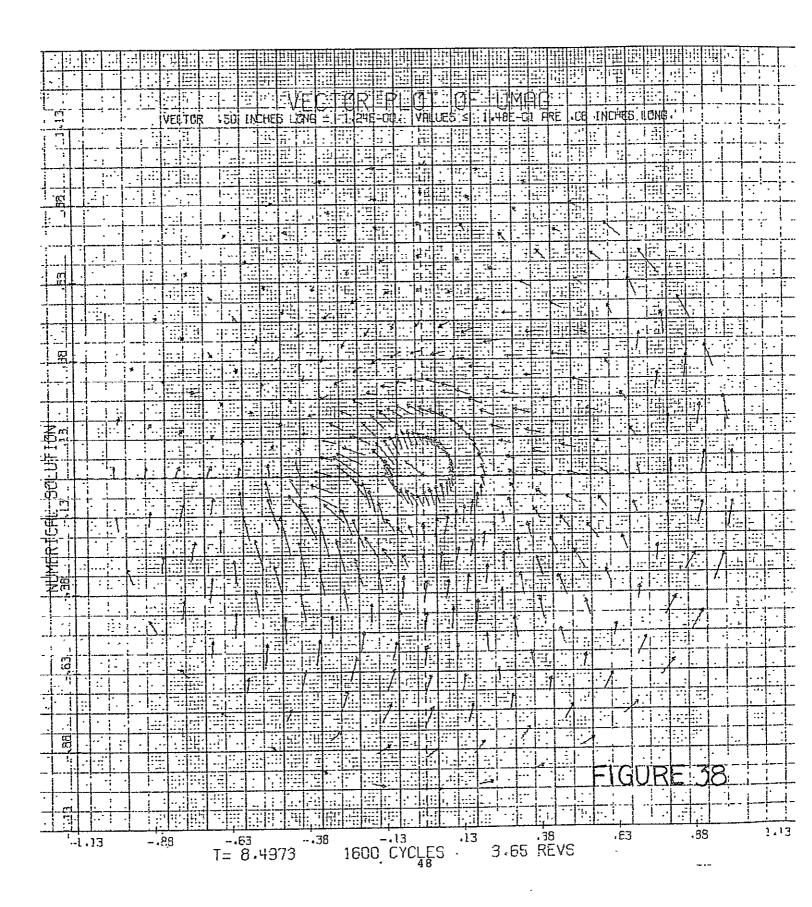




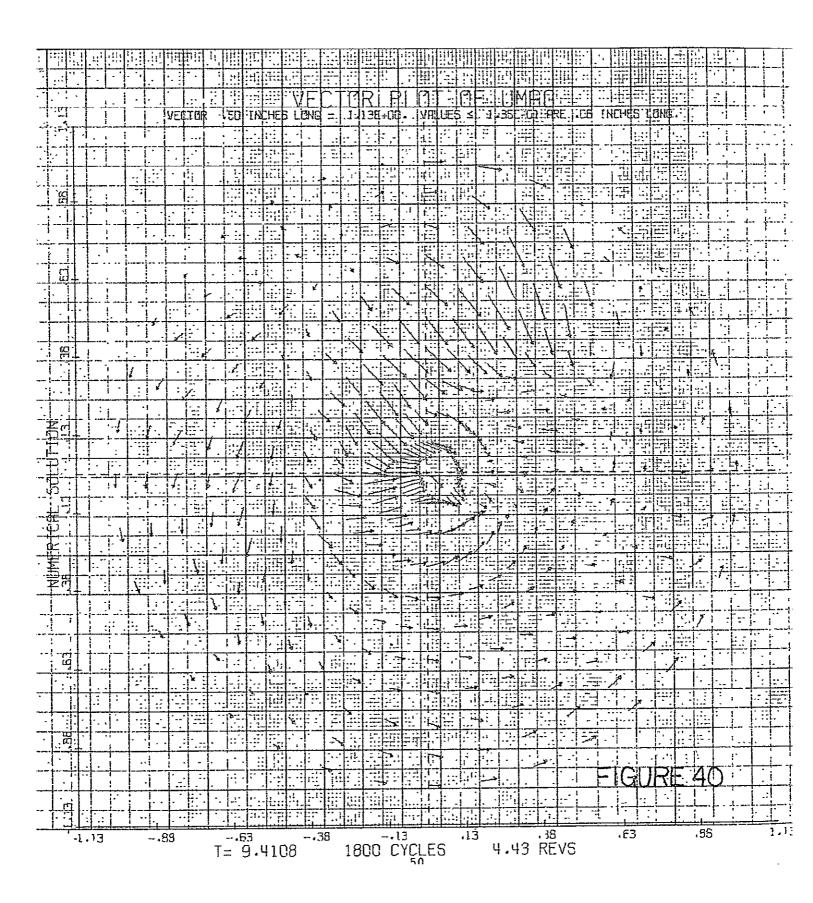
																									<del></del> ,						···			
		· ':İ	-	·;·	1:13			1::	. !!	Įξij			i: .	., .,		1	#:			45	=-	獣	ĿĘ,		HH	1			7.Ti			::-	٠. !	•
7.	. [: -	;.		•	.:	- 1	:!.	ii.		::!	ļi;,	11:	II.	- 1	:::¹.	<u>;</u> .	ijŤ,		11:	12,2	-11.	įį.	. <del></del> .	:4:	1. 1.	1111	111	1 = į	-1-	11		-11		
		- :	1			:	:: <del>T</del> :	, [1	11;1	= 1	1114	17.		1.1	:::	11.2	EI,	1::				Ξ.,			11	FIE	7,			:::		7		
							1		• :	: 1	1 ; ;	<del> </del>	•		: :	- :-	4		<del>     </del>		-13-	Ŧ		****	: 15	, ti.	:	••••	- :-	12.	::::			· <del>-</del>
					.,,	- 1	1 .		,	**	11:2			• .;			7::		: :		- ::	;;.,	****	,	1 4	:::		- ,	12.	7.7		<u> </u>	<del></del>	<del>-::-</del> -
ئـ								1		: ::	111		3 * . *					<u>-</u> ;}						-11	-11 -1,-	- <u>''' -</u>	:::	Ľ,	12:	ıjı.		-1		
- 1,		٠		;;		.¹.		٠:	1	:: '		::,	::	:,:	:		21.1	:::.			- ::	<u>.</u>	777	;;;	-11	715	:==	1	111	* :	٠.٠	<u> </u>	بندا	
	! :		.:	:			- :		از عدث			4.1	1,	. :: -:::	::-	<u>.</u>			_15		:::.	=	-11	1			<u>`</u> [^	-1.		1;1	. :		· ·	.;
,	i nondañol I nondañol				· :	= -	3	L.	۲۴		1;;}	ήĒ	: :	E	ήĖ	)	ΣĹ.	ΪŽ	<del></del> i	-2:-	1.5	ሔ	==	71	::: <sub>`</sub>	٠.:	ΞĿ	: ;	.;:-	ĮĮ-:				· i·
,		÷ .			$\cdot$			1.			- : 3		₹- i	3 /		j~_	: : :	. :	11		=-	:=		`†	1	7.	÷	,,,,	-::	: 12.	į:	·	. 1	
		•			.:-				,,,		1	1,	7								-;		Ŧ.,		, 11.		1	. ==		- : -	:			
~ ; ,	! ! .						71		17		7	1	1	-		—; <del>-</del>		X		$\overline{}$		-11	, 1							L	<u> </u>		i	
_	<u> ;</u>				<u>.                                    </u>	-	1	<del>  '''</del>	<u> </u>	/	1	<u> </u>	<b>-</b>	<del> </del>	<u>د</u> ر" درا	<u></u>	177			:	- X:		<del></del>				٠,		-		-:-			1
,						-/-	1,	<u>/-</u>	ــــــــــــــــــــــــــــــــــــــ		<u> </u>	: -	-	<b> </b>	<b>/</b>						-/						<u></u>	56.	ce	NĪ		ŖЩ	Ę	ÆĽS-
į 6	ธยกร-ฮร					<u> </u>	196	1	1: ,	<u>                                      </u>	::!;	Ш,	/:	منتمز	رجا		<u>-</u>		<u>;,'</u>		$\vee$	1	<u>`</u> ;:	1	#	<u> </u>	٠.:	;	ij,	<b> </b>	7.	225 225	346	±00
1,			. ,		7.		1	<u>/:</u>	1			ĽĹ		Z	1		<u>- ii</u>	$\geq$	Ź		· ·			ا الم عندية	ist.	i. ;	·· }	:: {	D. "	111	<b>→</b> -			-GE
T			7	. /	:	·/ .	1:/:		تبزا	بببن	ΤÀ	1.4	<i>[</i> ;	1.1	4	1	/· {	1	ZZZZ	· <del>}</del> '	\;	بزر	翓	护	. ;	<u>:</u> ::	::1	نبية	: عد	<u> </u>	:1:1	163	SUn	. <del>-</del> 01
	·	,		1.7	- /	·		<u>.</u>	خرا	7.	7	1	7.3	1.(.	<u>(</u>		( {	- }	17	7	1	( E	7	۲: ۱		; ;	-;-;	1- :		112	11.	345	836	-01
<u> </u>		. 1		7			T.:	1	<u>r                                    </u>	<u> </u>	7	7		7	1		1.7.	4	141	17	11	7-	\	نتن	垣	į.	7.	- ::	41		11.	527	137E 105E	<del></del>
, <u>1</u>	lenut or	7-		<del> </del> -			17	¥	<del> </del>	滸	H	1:1	=	-	7	4	$\mathcal{X}$	7	-+	1.1	11	1,1	1:1	بر -	1		***	1		<b>=</b>	+	ooc Min	יוכיו	.±Щ
<u> </u>	  ccns-ci	<del>}</del>	Ļ÷	<del>                                     </del>	-	<u> </u>	1	<u> </u> .	- ,	VIII)	17/	14		1	7.1	-	17.7	7.7	<u>X</u> 1.	1	1	- {	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	12		<u> </u>		=	<del></del>	12.	,77	יובית ספם	בל בן. שכים	.+L1.
	·	Ц			i-	! !/	[]	<u> </u>	- {	/:-/	14	- <sub> </sub> - -		//	1-11		$\sim$	7	7.			<i>:\</i> ;	-/-	II	4		1111		<u> </u>		5.	DEE F 1 J	יבבט אורה	±01
<u> </u>		1	·	1.	1	<u>Z</u>	1.	1:	11	<u>E4</u>	Z.	<i>V</i> :::3	$\gtrsim$		1		٠٢.	17	71,	٠		.:		11		• •	:: .	<u> </u>	71:		7	459	192	.∪; <del>]]</del> -
<u> </u>	• ,	1.		1	•	Γ.	1:	Ţ.,	1	3	N	~	-	. در	٦٤.		$\mathbb{K}$	1		. /	7.	Z.,	772	ZZ	77	. ,	٠.	- [.	ZLI:	7.25.	12.	620	1256 1476	-01.
$\mathcal{C}$	Ĭ. , .·		:	-\ 	<i>)</i>	i		1	17.1	Įλ.		<del>,</del>	1	7	1	Б.	×	],		. 2	مبسب	بزر		1//	Ħ	;; .	12		<b>*</b>	1:1:			1566	
다.	CCOE-DI	}			7.		11	-	17	1	M	K		(				7.	77	7	مبرا	الراح	77.	7.7	77.	· .	;;;;		X;		2.	264	648	+01: ·
.[날	11	<u> </u>	<u> </u>	(		<b>-</b>	<b>₩</b>	1		X	Ì.	:: 5			NE:	V::	يز:		7.7			:: 7	77	f t	fi	7.1	: =:			FII:	.33	-66	724	-01
⊋				<del>/_:</del>	-	<u> </u>	<del> </del>	1		17.1	17	1			-7	7		7.	44		+	1	1	÷÷			=	1::	<del>****</del>	1-1	13.	34E	1910 1846	<del>[+C1</del>
		١-:-٩		>	711		1,·	1::	1:1:	븲	11:	\ <del>```</del> !	7	4.	7	1.1		<u>-                                     </u>	<u> </u>	7	155	71		~~		7.5-	: <u>=</u> ;	1	1.17					
	<u> </u>	<u> </u>	i\ .	<u> </u>	$\overline{Z}$	Ļ		<u> </u>	<u> </u>	. 11.	Ш	<b>[</b> [. :	۳		<u> </u>		; ( j	.:14		/		2.5	//	¥	1-1:	1	1;	-	Ĭ:.;	1:;;			976	
<u>.</u>		<u> </u>	. `	<u></u> _	1		<u>'</u>	<u>]</u>	<u>.                                    </u>	:: 1	12	沚		<u>/ :</u>	11:	1	- 1		111		1	7.		<b>4</b> 12	<u>::-</u>		. 1	<u>-</u>	: :	515	3.	682 682	1065	
15	0006-01 ./								lini	:4:	<u> </u>	1:1	<u> </u>		<u>``</u>	.:			1	<u>`</u>	<u> </u>	·:·	₹.	::::	1, 1	7	- 3		<u></u>		i.	PEC.	10-20	
	1.7	T.,			ጉ _ :		[		[,:	猛	<u> </u>	13.	. : ]	1	1,		: - ;	i.	<u>.</u>	7	<u>`</u> ```	<i>3</i> 2		11.	r; -			: ;	T#	H	H	-::	-	.:[-
1,.	7::-	<u>                                     </u>	 		<u>`</u> _	<b>_</b>	1.7	Ţ		ا بانا	11:	100	7.	1. :	; i		11	11/1	布	]:/	ĘΧ		-[-]	<u>.</u> .	17	- ;			133	-E.	t =			
		1-	 	-	-	-	<u>ئ</u> م	ŀΖ	۱: ب	1	H:	11.	7.1		222	;	, ; ; ;	; i	N;	بمتر		1	::.	[: - - -	17.	-		7	1	ij,	<del>ا ،</del> ا	T		
	1	[** <del>*</del>			<del></del> -	ļ	; ; <del>;</del>	<u> </u>	74		1	<u> </u>		1::-		ا <u>' ' ا</u> نر : ' ا	ء بىسنى	1	بر + النا	• •	-1	:	11'1 11'1	1 !		Deat			<u>_</u>	111				
	द्राप्ताई <u>-क</u>	-		<u> </u>	<u> </u>	ļ	<del> </del>	<u> </u>	<del>                                     </del>	9		1, 1		2	-		- 2	31	4-11		<u>                                     </u>	: -		<u>                                     </u>		ļ	-	-	1111	127			<del>[</del> -	
<u>. j.</u> .	2018-02	incoe The second	-00	<u> </u>	غنا	[32;	<u>53</u>		į: <u>;</u>	T 149	r iii	اتــا		l ei	ĿE			т. <del>771</del>	E.1	<u>.</u>	<u> </u>	V.			<u>  [</u>	DOĆE	an:	<u> </u>		14:	**-	ļ	ł :	<u>                                   </u>
		ncce :	İ	<u>J</u>	1= :	<u> 7.</u>	63	66	<u> E.</u>	<u> </u> : •	1:1	at	} :(	<u> 1.YC</u>	ĿΕ		· ÷	: :	3.5	29	<u> R</u> i	<u> </u>	2:			<u> </u>			踖		<u> </u>	· ·		·-  ·-
••	-				ļ. ·		:									١:,							;	١٠;		:::		[	1-51	=;	1.	L		
		†		ļ:	7:	ļ .		у <u></u> - ј	1.	- - - 1-1-1	1::-	1	:	31	<u> </u>	::	:	::	![[:		Γ-	:	;;	.:		ſ. "		Į.	٠. :	[ 5	i	7.		
: .	<del></del> -	<del>  :</del>		<del>  -</del> -	] ; :   · ·	<del> </del>		†	<del></del>	<u> </u>	   .	<del>  • • • • • • • • • • • • • • • • • • •</del>			<u> </u>						<del></del>							 !	ļ	ļ .		: -	ī .	
					1	• • •	<del></del> :	<b> </b>	r Ter	<del> </del>			1	<u> </u> i	R	_	7	5			L	<del></del>		-	-	<b>}</b> —	<u>:</u>  • :	; :	:		†		ŧ	 
· · · · · · · · · · · · · · · · · · ·	! !:	<u>                                     </u>	ļ	ļ	<u>.                                    </u>	<u> </u>					1	-	G	أنيا	ĽŽ	Ç,	لدا	الن		<b></b> -	<u> </u>			1 .		<del> </del>	Li	Ļ	1	<del> : :'</del>	<u>                                     </u>	ļ		
. :	1 :	ļ	! 	ļ	<u>!</u>	<u></u>		1	1. 5	بننا	<u> </u> :_	1::-	: ::	ļ		<u> </u>	زن				ļ		Ļ		:				-	i ^`	Ţ. <u> </u>		į.	·
		· -	1		<u>                                     </u>	Ţ.,	]		1:1	-:	<u>[                                    </u>	1:::.	1:15	<u> </u>	<u>i</u>		î	1;	1.	:	<u> </u>	<u>                                     </u>	13.	:    :	:: <del> </del>	ļ.		<u> </u>	1:	<u> </u>			; ;	<u> </u>
										_				-	4 !	Ξ.																		



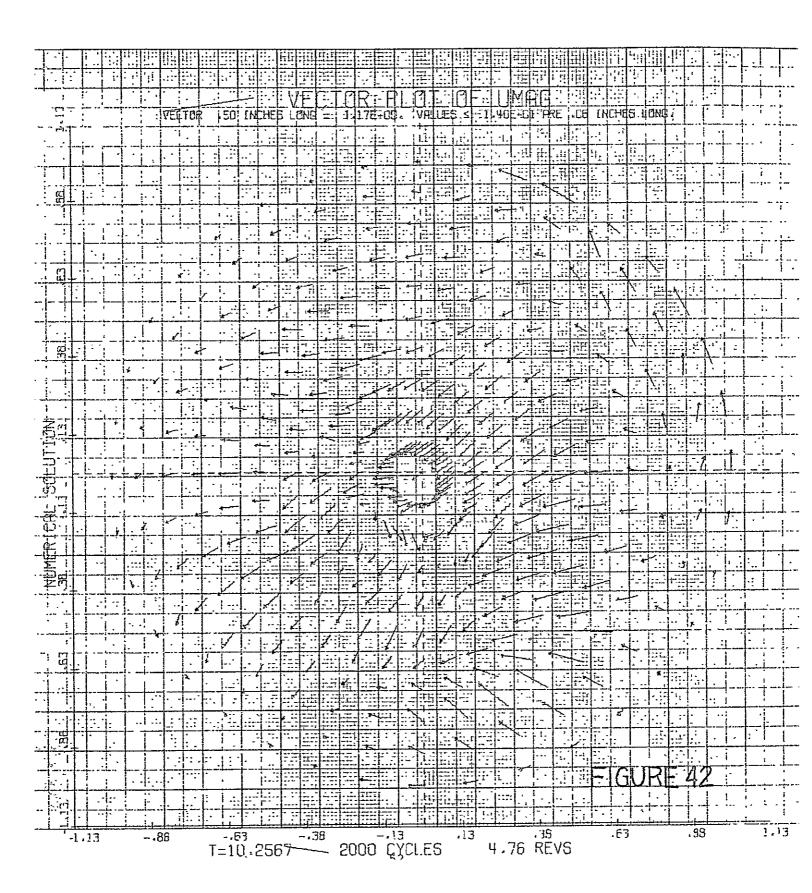
		<u> </u>		iizli		ш	::1		1111		::::		   <del> </del>	111		Щ	Ŧų	151	Hi	:::1:	liti:	朏		j:# <u></u>	   <del>    </del>		1:11	   :::		-  -:	··  -
	-;: [11]	1	-7:				7-:	;;;; <u>;</u>		= ;	2455	ii.	,r:	45		.:	Ēr		:=:	.1::	-  <u>-</u>	<u>:</u> !}_r	H	in ti	m.	, L ' 1	1.1	-	<u> </u>		
		i	j			.,:					: :			:==		: ::	11.		1 7	_[.		1	i,			ř. j	- E'			ļ	· - }
		1 ,				: 12		. = ;-	. 12 . 12 . 13 . 13	==		: :		-		!	1::		٠٠٠,		"1	ī.; ·	1.11	.;,	11		, ,		ţ 	i 1. ]	-   -
	1			<u>-</u> -		.5.			-	-, (	:::	÷	-	<u>.·,</u>			្ក			· .	:	: _			1.7	-71		<u> </u>	;	ţ~~- <u>:</u> ~	
		<u></u>	ا		:	T.		E		===		٠,		: <u>:</u>	7	- [5	ii	::::			. <u>1-</u> f		i.	÷÷	-	. · · ·		-	 !	<del> </del>  -	
	: .: .: .: .: .: .: .: .: .: .: .: .: .:	1 7.	*	: 1.		- : :		:			14.2	====	- ;	1111		1 -			<u> </u>	11	- 11		:			: :	-,	<del>                                     </del>	 I	<del>-</del>	
					#	1(	1				P	虎	-6	S		₹	·i;		:-:	<u>.</u>	<u> </u>	111			-::-	117	117	ļ.,	1 -	j	
	. ;	-	· d				3	<u> </u>		<u> </u>	Ť	- ·	/-	) '''	:	••••	- ': ::1:			7.1.	. '	1 27	FB		<u>1'.</u> F	- L	- [-]				
			_	1	;; <b>;</b>			::!		=	::	1	<i>(</i> : .		1	· .			. ,	٠- ــ ز	.::		17: 17:	٠;		ī.		ļ	i		
	`		, ,	~~							1-	115	Ē	-5.		- ; - ;	11.	3		-j:-	: ::::	` ; `	;	;	2.1	17	:;;	ļ:	1		
			7	1	:: ]		:=	: 7		7	77.	E.45		\- <u>-</u>			5, 4	= }	- <del>11</del>	11.	‡+ _ t	::	1 1-		:::	: ,:	74.1	í a			· -
F. Onne-or		7	:	, . <del></del>				7.1		ij		1	<u> </u>			1		154	. 7	2,	if:	.,1	11.7	21.	E	: :	44	HÚ	olt.		.V <del>[[.</del>
		<u> </u>		ĘĖ				: ]	=	يار	# -	1.5		بزر	-			7::			1:	;;;;;	:::			Ö.		1	ة بـــد بري:	# / 55 # 1 9 F	ξ-+
		اببر		1	$\Box$	=			===		] -	7		;		- ::	7			7	,		1			Δ.		1	: 45!	399#	<u>:</u>
							<u> </u>		111	=	- ,		:1	<del>.</del>	11.	Ξ.	;;;	<u>:</u>			<u> </u>	<b>/-</b> :	::=	11:	777		111	:::1		\$852	E+[7]
Ki iii	ن بارد ن بارد			$\frac{1}{\sqrt{1}}$	:					= ,	4.			7:			<i>J.</i>	1					æ	::.	<u> </u>	生文や	1	- 1	:61	709	t-lit
15 330E-07		-	==\	1:1	7				7				\	7	131			:::		Ξ.;	ii i	屰	1111	1.33		· Ø.		<u>-</u> -	-64 -61	\$567	E-+  -
P				- 1	⇉		Ž	- =	$\equiv$	<u>=</u>		7. 1		· · · ·	7 : 27		7,1	-11.	1111	<i>y</i>		17.7	7	***	7.5	· 文:	===	+	.2	4585 5165	5. <u>75.1</u> F.+[7]
		==		<u> </u>	S				₹				Ċ					ij	7		T:		717			芝	: <u>1</u>		741	\$140	εibi
	7.	; 4		=		-1:1:	7:		₹:		#		Υ.	E . T	7	<del>/</del>		- : : :X:	1	-14	1	- 2	1:5	115.	#:	: Y I		- 2	7D	<del>1997</del>	<u>E+61</u>
- F					77	Ħ£	Ħ,		-	ا -/- ا	=	三	72	V			12.	-	1			7	- ;	<del>-1-</del>	121	*)*C			-8	<b>885</b> 5	E4D1
2 -2 -3106-01 \$				=	₩.	JHI.	4	بالمرا		==	7=	.7		77:				7.5		1::-	1117	7-1	1	= 1	-1	X-	• ; ; ;		.3	157ti	E+31
中一十十十十十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二十二	7/5		ررک ارپر		11	1112		- <u>}</u>			1 54	1223		.: <del>.</del>	1111 1111	7	LL	; =	1	71.	7	: "	, E,::	-3'- '- ;	157	:1:	27.	7.		2428	
	//-	اب.	7	<i>f</i>   }	77		$\forall \forall$	17	-}		17					<u> </u>	4	===				7				70.			.7	285	E+D1
	<del>{</del>	<del></del>	./	/=  - 	z	illi.	117	577 122					=				:::L: ';;;	77.	7		117	7	71 <del>5</del> 1		교	: <u></u>	1 T_5:	15.5	: <u>'</u> gı	143	E+C1
	\\\ :\\\\:		<i>-1</i>			#	14	-7:-7: -7:-7:	, : <u>`</u>	$\equiv$	1	===	===	-1	E			12.2	••	12.	7 .1 ·		3.			<u></u>	7. 7.	7-1	- ]	ECD).	<u>E+1.)</u>
- 6.0 0E-31	/ /		$\hat{=}$	$\mathbf{x}$	7	拂	$\mathbb{H}$	掛	Ź	Z	7				E		::::	7		===	7 -	 (:	-		1 -1-	* ** ** * ** *		7.1	-5	\$716	E+11
	. : : : :	$\geq$		حرب	2	77	扫	1	= 1	== <u>7</u>	Ţ.	7:	- <del> </del>		=	-بر -•.	-12	7	-1 <u>:</u>	'y' '	1227	2.5		<u> </u>		=		- 4	-7		±÷1
					4	//	7	//	/	<i>‡</i>	ير		مجر	7	皇	<u>.</u>	-1-		ز. :	<u>4:</u> -			<u>"</u>			:	:-		Ŀ	ļ	
			; <u>.</u>		4	27		<i>‡</i> ∦				(				-12		-:		·::	!T.	7::				1	<u>.</u>		! ! <i>-</i> -	<del> </del> -	
	-1, 1,				쉬			异		-	1	===			5	-	7	- ::		-, <u>-</u>				<u>:</u>		, ,	.1	:	<u> </u> -	1	
	1.0.0	<u>:==</u>	121	-= [	-					7/	E				i =-		11:	1,71.	elt:	-1	: 11		? <u>!</u> !!				,m.	i:-	<u></u>	::	
		<u>[</u>	5-5	:::!: :E.dT	1	77		副			<u>F</u>		ŋġĨ	-1-		ii:E	G)	2 - 5-	155	::: -:	11:1	(건) 닭		٠ -		- :	;		ļ		
	- 1	ŢΞ	8	:49	7	}. :		=1	60	0:	<u>[ }</u>	<u>Cli</u>	EE		117	<u> </u>	:6	F	۲Ę۰	<u>'S</u>	1:1:	=		- 1.	<u> </u> .			<u>::</u>	::	Ľ.,	
1-300-10		<u> </u>	: 1 T	:		[	==	:		==	==	:. = <u>:</u>	1:1:	==	#		.: -	<u></u>	.: 5	<u>. `</u> .	٠, ' <u>-</u>			·	_;			[	i 		
								==1			#=		= ;	1	ļ. <u>i</u>	;:	i: ':		r- ·	<u>:</u>		:   !				·	. :	<u> </u>	<u></u>	<u> </u>	
		:::	:-; <del>-</del>		:- <u> </u>						11		i.f.	<u> </u>		٠.:			• •	· : '				·	<u></u>		-	<u> </u>	<u>-</u> -	ļ	
33.5	: 11	÷, -;		; ]		<u>-: </u>	Ě	===			(j	IJ.	K		3	1.	:::	,	, ;	٠,	ŀ				<u> -</u>	ï		<u> </u>	<u> </u>	<u> </u>	_
		::::	= ::		<u>:: </u>				-==	:==		<u> </u>		=====	= ==	:	 11	<u> </u>	-	٠		,			<u> </u>	: . :	-,		! <u>-</u>	<u> i</u>	.
	î: i :	]:	ī:;.	::-; <u> </u> -			:		==	:55	.ii		: 1	ı E	i'i.	:::	ı:!I	ម៉េរ	,		•	11	: '	·	, :	٠	:		•	<u>l</u>	
													4	/																	



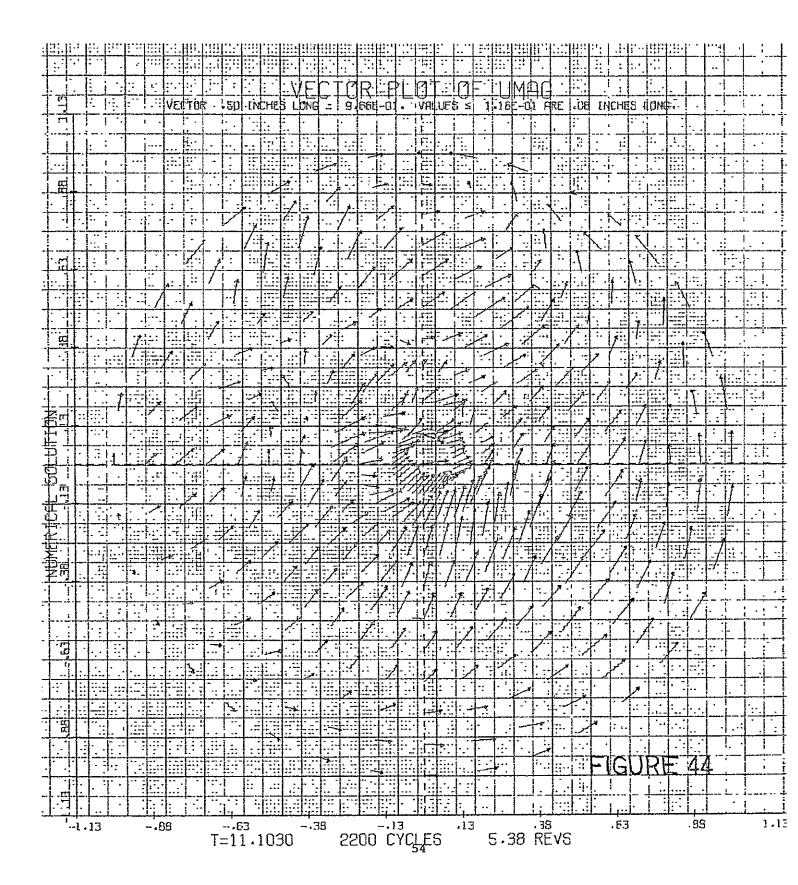
	70000100001		britt Elminol		
		: 1::::	in 1 in 1 in 1	1 1 12 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	
			F- (-)	1.   1.   1.   1.   1.   1.   1.   1.	<del>+</del>
		1. 15.			
ndor dal			tigan ka		
		~ + + 7 1 17	力力是一二		
			们压力		引用智慧的"基本"
	/ 1 · · · · · · · · · · · · · · · · · ·	1.1.1/1//	7//		
†		11/1/1/7			לייל למונים ומונים לעלי ל
		<b>4/1011/1/7</b>			
: In-3000.al::					1112 1012 1013 1013 1013 1013 1013 1013
1-1-1-X-F					HE-72-113.2 8895-01
					न्त्री वित्ते <del>स्त्री वित्ते वित्ते वित्ते वित्ते वित्ते वित्ते वित्ते वित्ते वित्ते वित्ते वित्ते वित्ते वित्ते</del>
				17777	7C - 1.76229E-61
					7) - 7 - 7 100 (400 1)
- 12-000E-07-				17/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/	
					16 20 6-364935-011
P. 11 (19)		7-17-18	14 10 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
					######################################
					½:129716465E÷01:
F-5-208-57					X-1-10-3-39643E-D1
			计制工集 指电		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
				作計畫指導法國	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
					111 字符记:4:243526-01:
	: :				- 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1
					1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1					
		1800 CYC		73. REVS 7.	
i grenn					
1-70-02					
1.00=-3	150 3	13E 12 12 12 12 12 12 12 12 12 12 12 12 12			
<u> </u>	4108	H-11800 LYL	TED. HILLAR	13REVS	
	1 * 1 * 1 * 1	der i saltanilar dad	`:l.:::l		
		FIGL	JRE 139		
	1 4 24 1414		JR 39		
			: 1 . ; ; ; ; ; ; ; ; ; ; ; ; ;		



			<del></del> -																		····	···	<del></del>				<del> ,</del>						····		
	. 1 4	101		1::		: ::		1;	1	1	154	##	i, k	111	14.	Ψij	.∰.	i	$F_{ii}$	1.71	- +	11	7, 5	: ; ;	, []	<u> </u>			1	11:	<u>'':</u>			. ]	
	1.1.	1		-: '	11:	ii,!	• ; ;	:::	: .	77.	7	Πį	įΗ		11-1	• • •	Щ.	111.		11.		1	11],	١,, ١	1:	<u>=</u> .		٠٠.	- 1	; <u>.'</u>	: .	j: ; j	1-1	-	7
### PEG OF PRESSURE SITE 1			1	j		٠.	:				. , .	1.1				. ; . ;	7:57			<u>,:</u>	-, 1	1	::.E		.:-					; ,		-		T	
				<u></u>	<u>!</u> —-			, ,				11:3	11.			ı.		7:			1 1		7		<u> </u>	-	<del>: : ;</del>	: :		<u>;</u> :.;	: -,	i [	:		. •
	سند الم	<u> </u>	-}-		<u>.</u>				-											* : - ! :	<del></del>	- ',			 		<u> </u>				<u> </u>	;	<u>:-</u> -	<u>-</u> ;	٠.
	· · · · · · · · · · · · · · · · · · ·	; <u> </u>	<u>;</u>		<u> </u>			<u></u>	*.:		`. :		14.			-		====			.: .				-::1	Ξ:	1			11.1		}			
	<u> </u>	<u> </u>	} ~-}		.::				<u>:j</u>	_=	:::	ir.	:::.:	···	1!	•	·	Ξ.		. :	:	: : :	::::			-					-,	اًا	ļ		- <u>-</u> -
	1	ł	. E.		.:				` <u>`</u> .	,,.								==	!	-: `	ij.	.¦Ę	7				`, ·l	f!	. <u>:</u>	1	:	<u> </u>	i	<u> </u>	· .
10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,572.9    10,5	1,-4	der col		.	,		- 1		بــا	U	, ,	Ü	· .	٢	ļKt		G	إيا	ζţ.,		,-:-	155	計	;;:	· .i.	: 1	-	: '	-17	1:,	` .		İ	1	į
		400-001				1		!			<b>:-</b>	7:		ľ.		<del>,</del> ;					•		÷. ' ;	1	::::				٠.:		ļ		. !		
16.5786.9	•	!	- ; -		1 .	' }		i	·	1. [.	;	<u> </u>	:::	-1	:1:	; <u> </u>	:	.,-:	],	. :		.,1	FEF		47					,				• • •	:-
DO CONFOUR LEVILS    1		·· - <u>-</u> -		<del></del>	;	·	-					<del>  }</del> -	-	T		-						 	īī						•		<u>.                                     </u>	 1		Ť	•
		·, - ÷	-	<u>-i</u>	<del>  .</del>	احر: ا	r		<u> </u>	1	(		<del> -</del> -	$\perp$	1 .:	2		(::		7	<u></u>			,,;-		::::	<u></u> -	; ;: :	: 25	1	==	L  !	j		
P		<u> </u>		<del>-</del> ;	1		<u>.                                    </u>		1 1	-	-		111	i Ì	7	-:-	$\vdash$		2:	-	$\simeq$		3			==	<u>:.:</u>	20	Ë	βŃ	FÜ	₽R-	-F	/ <del>IL</del>	용-
	[6 <u>.</u> £	<u> </u>	ļ	. ۔ نے ۔۔۔	ļ			<u> </u>	<u> </u>	<u>  -</u>	1	1-[:1	: <u>:</u>	<u>F.</u>		7	=		:::::	ļ. 	<i>)</i> ;		=;/:			<u></u>	-::	+1 t	ED.	-	. 6	1-718	51\$E	: <u>+</u> po	_1_
Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Cont	1.1	<u> </u>	Ĺ		1-	1	ļ	1 :	3	1		127	<u>                                     </u>	۱, -	1.:::	<u> )</u>	-	===	===	1 :	:;	1:5	::::	\T; -7;	: 55	ᆵ	:	Œ:		= :	<u>: : :</u>			<u>- [] 1</u>	
Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Control   Cont	·		[	4	<u> </u> :			ļ. <u>.</u>	. :	1:1:	<u>  :.</u>	<u>  ; ; ; </u>	Ŀ	ŀ	1	跓		ļ " <sub>r</sub>	$\leq$	.:::	<u> </u>	1:	113	٠ <u>٠</u> ٠	E : :	#:	·::.	,	L	[:4]	: :	i	<u> </u>	.+D1	
	,	ì		-				ŀ	::	11:	:		1 :	Ţ-	H	\		[ ]		ļ	مر	[ <del>:</del> \			١.	=	==			<u>                                   </u>	<u>; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; </u>	: !		•	, 
Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Section   Sect	N.		7				1	į.	1	1-1	Ţ-Ţ-	::-	- 1	;f.,		لببر	Ţ-	17		ļ' .	• ,	•	- · ·	Ţ.,	• •	-111	. :=	рī		:		րու Մարդ	1	:∓U) -∡(}1	-, -·
ESC	E :2.5	 :duz-or	7¦-	j	1:	İ		<del> </del>	7.		T	1.	<u></u>	<u>;                                    </u>	1.	-,:	1				::	(	F			Ħ: 1	:			15.	. ,	1.25		- 101 - 1114	•
ED		11 - <del>1</del> - <del>1</del> • • • • • • • • • • • • • • • • • • •	سنبا	<u> </u>	Ļ	! !	<del></del> ;	<u> </u>	=	×	<u> </u>	-		+			<u> </u>	- :	/=			7.	7:17		÷r:	1				71.	: 3				
E - 2-150 - 2		لدا ما ا			1		- 2 - 2	-	; ::					7			-						7	i , i		1	=::	1	Ź			75	iD) DE	:=(D)	
				<u> </u>	<u>  : . }</u>	7	<u> </u>		<del>  }                                   </del>	1	<u> </u>	<u>::</u>	17,	4	<u> </u>	7	7.5	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	<u>-</u>	جزا	- ·		φ⇒	7.	-0	4	===			r:		1-3:	<del>190+8</del>	<del>.     1</del>	<del>-</del> -
2 - 2 - 2 - 3 - 4 - 5 - 3 - 4 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5	· Œ····	<u>.</u>	<u></u>	٠ا	<u> -</u> -	17	_/_	1.	Ι.	<u> </u>	<u>[]:</u> _	برز	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	Ų.		<u> </u>	<u>/ : :</u>	<u> </u>	<u>                                     </u>	[ <del>./.</del> .,		:: \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	1-7-	1-7	$\vec{J}$	; <u> </u>	Ξ.	Ţ	.д.	<u> ;                                    </u>	-:	1.2	:1995		
		ئات ئ	1		<u> </u>	<u> </u>	<u>.                                    </u>	1 1	1	1-		13	ببرإ	برن	<u> </u>	1:7	1	= :	厂	Y.L.	/: /		[:[:]	11	1. [	<u>;                                    </u>		<u> </u>	Ж		:::	4-			
T=10.2567: COCO CYCLES .H.76 REVS L:	- F6.0	₩-#	1	Ι.	-	1		<u> </u>	1	L	1.		1.7	1 -1	$\hat{\Psi}$	)	<u> </u>	7	$\mathcal{L}$	7]	مرز		F. (	31.1		. 6-1		7 3	Χ.	=		17-1	15898	[+D]	
T=10.2567: COCO CYCLES .H.76 REVS L:	. <b>E</b> 1		V.	; `	1	<u>.</u>  .		۱.	/	1,4-1	. 1	1	序	}		<b>1</b> 7'	1	X7	///					F	: 3	:T=	<u>:</u>	, <u></u>		HE	Ė	1 . J.	14010	لال +ـ مخاـت	-
1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1					1.		1-	-	1			1	7.	1	<b></b>		۲.	7	611	7.7	71	11.	H		7	: = [	<del></del> .	1.		ļ:		ļ. u-	1075t	ינן ינן	
1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1	1	T T	- *	`	$\langle \cdot \rangle$	<b> </b>	Ι	1:5:4	111	1:1	ķ .	X	<b>\</b>	7	->-	1: 1	1	1/2	7-1	X:	7	17	7.			Ξ.`	7:	::/:	j	٠		i . 6	1.58	-b1	7
16-3-2-4, 13-3-3-3-3-3-3-3-3-3-3-3-3-3-3-3-3-3-3-		+	_ -	<u> </u>		1:				+		- :	<u> </u>	Ť.	<del>  ; ;</del>			V= 7	7	بنيا	2,	<del>7.</del>		×.7.		1	•••	7	: 1.	<u>.</u>	2: 1				<del></del>
		:चिट-ग्रा	- -		<del>                                     </del>		÷	11 21		-	K	÷	<u> </u>		7	Έľ	1	-/:	ب	₩	#	1:	7	Ž,	727	-	-		7:	-	-				-;-
T=10.2567: II. 2000 CYCLES III. 70 REVS. LE III. III. III. III. III. III. III.	1 :	+ "	. <u></u> L		1			<b>-</b>	<del> </del> -	$\leftarrow$	1	<u> </u>	<del> </del>	<u> </u>	1	7:	-/-	II ~		7	<del>2</del> :	1-2-7	) ()		====	-		(	=	<u> </u>	<del></del>	<del>] -3</del> :	<del>lotiki</del>	<del>:-þ1</del>	
T=10.2567: 1.2000 CYCLES : H.176 REVS Ls : T	·		<b>_</b> :-	_;		 		: :					-			سنبن	1	بسنا	سنيا			÷	==	<u>:-</u> -						1 -	ļ: ·	· ;		<b>į</b>	
T=10.2567: 1.2000 CYCLES :		<u>.</u>	_ [.		ļ									+				سسيد سيدو		-	=	<u> </u>			ļ <u>.</u>		<del>.</del>	<del>!</del>	<u> </u>	12	-	<u> </u>	<del>!</del> -	_ <u>i</u> _	-;-
T=10.2567: 1.2000 CYCLES :	.1 . !	1		;	ì	<u> -                                    </u>	2	4		1=-							$\equiv$			· ·		<u> </u>  -7,	5		171			<u> </u>				1:-		/	
THE FIGURE AND THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF			: [ :	1		Ī		1				1		È	-			<del> </del>	15.5		<u>.:</u> -,	1:1	Œ	::::	1.1.	ï.:			: !:			,	-	1.	· 1
THE FIGURE AND THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF	-   -	10E+23		<del></del>					-			1		in a		îII.		1				:	E:i	<del>:</del> "	2 2	1		1:	=;	:	Ţ., ·		.:		,
THE FIGURE AND THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF		<u> </u>	EFE	- <del>()</del>	r_	15 T	5	er ce	7::	<del>1</del> 3.1	Tr.	֓֞֜֜֞֜֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֡֝֓֓֓֓֡֝֓֡֓֓֡֝֡֓֡֓֓֡֡֓֓֡֓֡֡֡֝֓֡֡֡֡֝֓֡֡֡֝֓֡֡֡֡֡֡	'n	ال د	Jr.F.	UC UC	- : :	12.	12	7	h	₽F\	ici	1::	-::	, <del>182</del>	<del>ان _ر</del> :	·		1::-	.::	Ī÷	1	7	
THE FIGURE AND THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF	<del> - -</del>	-1	<u></u>		╬═		ا د	<u>ن ر</u>			1		1	اجا			+	1	-			1		4	- :				-	1 "	i.:	į,		1	÷
THE FIGURE AND THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF			-‡-	#:	<del> </del> -			<del></del>		-	1:1					15.	ļ	<u>[</u>	- ==	1		[-	<del> </del>	-:	-		<u></u>	<del>[</del>			1	!	<u> </u>		
THE FIGURE AND THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF THE PROPERTY OF		ےئے۔۔ل	<u> </u>	<del> </del>	<u> </u>	1		1 .		1.:	1:	-	1:	<u> </u>	: -	1		<u> </u>	-	1	-	11.	<u> </u>	1	ļ · · · ·		_	<u>                                     </u>	<del>ا</del>	<u> </u>	+		<del></del> -		
			-	 	<u> </u>	ļ <u>.</u>	ļ. <u>:</u>	<u>! ·`</u>	1 -::	: 1	:-	1:11			ļ.:	[ <sup>7</sup> -	<u> </u>	ļ	1-		:	<u>!</u>	<del> </del>				<u>-</u>			<u> -                                    </u>	<del> </del>	ļ	- +-	. <b>Í</b> -	-:
		1		.	<u>  · · · </u>			<u>: :</u>		<u> </u>	I	-	[C]	<u>ال</u>		<del> </del>	4	1:		ļ.,	<u>:</u>	1 -	<u>  'ı</u>				<u> </u>	ļ. <u>`</u>	<u>  : :  </u>	<u>!</u>	_				!-
	,			<u> </u>	. 1			i	<u> </u>	·   . t',	Ĭ			4;		į ,	<u>[:`</u> .	1.:	Ŀ	<u> </u>		<u> </u>	<u> </u>					<u> </u>			ļ	į .	i 		
	1				i	[:;	,	ļı. :	j	12.	[:]:			:	- :	<u> -::.</u>	<u>                                     </u>	ļ.Ė:	7.=	.:	<u>;</u>		<u>  : : .                                </u>	٠.,٠	l::	·	ŗ.	1 ,   1 •	1::1	<u>  :::</u>	L	<u> </u>	<u>L</u> .	Ĺ	



T	201014	ETTT I			THEFT	311150				1444	.1	ar ear			क्ष स्ट	a				सान	1	ı		2 223		<del></del>
		##				1: !! :	::11			111	1 . 4	11:1	;!!/	::11	1		백	FL!			===	<u>:                                     </u>	:	-:		
	: <u>I</u>	1:1	<u>:                                    </u>	4::  167	1.71	# 1.	11:	2 2				Ħ.!	111	[ <u>'d</u>					Ж	5.5				-:"		<u> </u>
	1. :		: :::		,	i Hu	÷, :		1:: 1	12	; }	Ĩ: ri	<u>.Į.:</u>	- <u>, :</u>	<u>:</u>		, [	1:31	! '	1:-	.			الا	 	
	. ]	] . [			•				: .		1 4			71.5	:-:	i.	<u> </u>	ji'l	· ` ;	ln;			٠ إ	. !		<b>!</b>
	: 1.		: ;;;;	. F				:-::	1	1 5	: 1	144	: ":					£1:1		11		;	-	Ţ		
	F	1				TIE:	11		3			14.	, u		===			7.1			;	<u>.</u> :		-,-;		
		1		1 1.	5:-	41 - 4	11.	- :1	1	.: <u>:</u>		12	;; <u>=1.</u> ;	ī, 2	- 1		::/7	E:	.::.	<b>F</b> :	•	<u>:</u> ;;.		-		
		<u> </u>		LiO		3	F	Rŧ		SU	RE		- ; - '				J.:	1.1	5.	Ė.,	,	:				-[-
1-0(		-4-1		-	اما	1.	1	*:	寸	15	4 ::	==	7 7	:	===	-:-	:::::	*	::F	Œ	::	,				
	<del>-  </del> ;			スゴ	\f	"=		7		术	<del>       </del>	ļ.::.		7-7	: ;	7	-	<del>=</del>		<del>=  </del>	:=-		:	-	·:	
			-X-	<u>;;;</u> ;	1 - 1	7	17		+			13	į.	<u> </u>	7.		7		<u> </u>		11				<del></del>	
	-	, X.	\\\.	<del>)  </del>	·)	<u> </u>		1				4:1	::		17		- <del>* -</del>   	[-]	- : : : i			· · ·	,,,, ,,,	1		1.1
	·   7	1		: [من - از	1			<del>[}</del>		21		1-1-				=-	 	71.		124	7-C	<u>en</u>	FÓ	₽Ř	<u>-                                    </u>	4.5
F-EG-E-ET	11//	1///			-	المراجعة المراجعة	7:::	<b>)</b> !	<del>}</del>	. \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	7 7	15.5		===	: ( ::=:	<del>(</del>	1222	<del></del>	::.	77	E	-			3035. Dene	
							TE'		<del>[]</del>	-) -	f F1	1:-[	7		-I	7	: :	=1-=1	· · · · ·	1	<u>L</u>	ه د پېښت		/: 	784E-	
			ارز امر ا ارز اس				11111111111111111111111111111111111111		-	( =	7 -	-1:-:- -1:-:-	1 1E		=-	<del></del> -}	121	==		H.,	+		= 1	.7		Gran i
- 1///			/ :/<	\// /-	<del>                                      </del>	<del># -</del>	<del>[]</del>		<u> 171</u>	· · / / -	<u> </u>	<u> </u>			7	<u>-</u>	1	<del></del> -		<u> '</u>	×	pr 7	- 2	0:	1 <del>979E+</del>	<del>Lı ; ; ;</del>
	///////	¥£.		/	1	<del>-}-</del>	(i)≥			·  -}		£.}	$\leftarrow$	-:-	-7	-)	<u>-\</u>	1	7.T		Φ.			_3	JS65E.	C1
5.20001		1	<u> </u>	- {	1		110	<u>) -                                   </u>	<del>} }</del>		\\ <u>::</u> ;	1 5	λ.		E.	; :	\ <del></del> -	ا مورا ا	7. 1	* 9.5	4	:-:	-16		1392£	<u>[]</u>
	////-	-		ندآن	15.7		1	K-	<u> </u>	#	<u>.</u>		-	1 :: _	-3	i-		1,:::	1	<u>-</u>	ブ	1	-112	93	iouke.	127 I
· [5]   · · · · //////	441	<u> </u>	: :::::::::::::::::::::::::::::::::::::	<u> </u>	11.17			1				17	, ,	2.3	:1:1	- L			1	<u></u>	Ζ.		***	Ç.	<del>19721.</del> -	<u> </u>
	$\Pi 1$	-		F .: [: _	8.3	γ. : :				/	4	1.	<u> </u>	<u>;</u>		ij.,	- ==	<u>:::</u> :	ii	1, 1	K		. L	1	3965	12
			-\i			12			-	/	: .	·[/:	1:	ļ -	1=:	Ξ.	I	Ι.	::	βi	<u>*</u>	# 1	71.L	: 21	20268-	<u>[]</u>
F +6-2405-07 12-1		<u>F.</u>			1	11 11		1,1			<u>.</u>	1:::	<u>.</u>	•	1	'	:+	1.64		:- 1	X	::'-	: L	.51	เปิงสุยเร	iss
<b>[ [ ]</b> [ ] [ ] [ ]	:. ( <u>  .</u> :	<u> </u>	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	:\\	1.7.	XĽ.		-	1			4	1	<u> </u>	j);		) <u></u> /			111	14 ·		= -	- D\	inolis. Takis	-61 <del> </del>
: P-1-1-1/	·/ ::	<u> </u>	\	.::	Į:	11		::	<u>i}:</u> ].		t: /	1::5		<u> </u>	12		7	1.13	; <u>;</u> ;	1, 11.	160	1111	- :	Ψį	135E	<u> </u>
	1.	<u>.</u> j. :	-:,)控		19.50	++-		ايزا	<u></u>	راز. عارز:			E	- î.		学.	ζΞ <u>.</u>	<del>11</del> .:	1	11#	:1:	<u> </u>	÷ ţ		.180E-	<u> </u>
	. /	<u>  [:</u>	·/:=		1		11:	í	1		ļi į	<u>HEI</u>	EE	17	: <u>:</u>	]:/.	1111	44.		.]17	:1:	=	:- E	0.	:187E-	HC1
F-30/66-UL	\	#/	/:   <del>- =</del>	:	1:5/	41.		: 1			1- 1-	·[		Z::=		11	H	117	• •	; 'j	. 7:		' - <u>1</u>	) . 51	15145	
1 1 1 1 1	: }	<u>Ţ.</u>	· [, 7;		12:1		. : -	:::	<u>-</u>		<u> </u>		12:	رتا	Δ:			БH		1	-	ļΞ				
	- :: ==	-l>		·· - / ·		7 - 1	: 4	1/	== .	. :   <del>.</del> :	-			حرا	ļ			÷i÷	<u>.</u>	; , <u> </u>		Ŀ		<u>. '</u>	, <u>, , , , , , , , , , , , , , , , , , </u>	1.
		17	1	1	1::		1.		·	· 1.	] /		1-	Ŀ.				1 1	· <u>·</u>		<u> </u>	ļ	; · ·	ļ''		i_L_
	-:1	- <del></del>	1:	-+	-1-		1	1.7			je -		<u></u>	1.		: <u>.</u> :F5;	-:	::	1.	1	<u>'.·</u>	1.	٠.		- 1	<u> </u>
		注		:				١	: <u>:</u> : <u>:</u> :		1		<u>.</u> .		VS.	177	12 11:11	10: 1:01 1:11		ļ. ;:			.:	1	1	<u>                                     </u>
1,845,4	-:- T		103	D::- -3		ado	Ċ.	YČI.	ËS	<u> </u>		5113	8: .	ŔĔ	<b>V</b> .S	· .	- <u></u> ;	Fi	. 31	,11:		:			· <u>:</u>	
1.5365 - 6			103					1				- 11		1.	Π.	- =====================================		Ę, į	.;	١.	Ì. ].	ļ., i.	::::	::	. 1 -	<u> </u>
								:[=:=	ŢŢ.		: [:	1 5	1	,:	:-:: ::::		[ ]	H.	[1]	ļ.,.	٠٠,		١. ;		1:	1: 1
				-  -	1	1 -	3 : :		i::.	-	:= [:		-	1	:: .			11:2	: •	11.	:	1	1: -		<u>;</u> .	
*							17		Þt	. /	IZ		† <del>-</del>	1	†	: I	ļ			1			ļ:.·.	<del></del>	<u></u>	T.
	· · · ·		1. 1:-		1 2 3		. <u>*</u>		: \*\ ::	-	T   '~		1:	<del>                                     </del>	ļ.	7	-:.	Ι.	Ī	Ι.	Ť		; .		Í	1
									17.2	<u>!!</u> :	: : :		1:-	1	1 -	<u> </u>	1		 	<u> </u> -	1-	†		1	<u>                                     </u>	1
- <u>- 1 ''                                  </u>			1. 12	1 - 31.	4	4.610		41	134	<u>!!!</u>		1111		1.	ــــــــــــــــــــــــــــــــــــــ	L	<u> </u>	11: 11	I	1.	٠		٠	11	<del>1</del>	·



#### E. Program COMB Status

As is shown by figure 26, we have incorporated the ability to selectively plot the tangential pressure distribution at any value of radius and at any time. This feature adds flexibility to the program for ease in interpretation of the computed results.

It is anticipated that the final report will contain some instantaneous streakline pictures of 'particles' moving in the  $r-\theta$  plane. The resultant motion is shown plotted as separate pictures after, say, one complete rotation of the wave. It is hoped that correlations can be made with these computed results and photographic techniques to be attempted by the JPL rocket combustion group.

The toroidal motor model is almost debugged. Tests are now being run to establish a steady state flow in the  $\theta$ -z direction with given arbitrary initial data. A simple approach has been taken so as to simulate a converging diverging nozzle. That it is necessary to incorporate a supersonic boundary condition at the outflow plane of this toroidal geometry is evident. For a liquid propellant motor the only other required boundary condition is that the normal component of velocity shall vanish on the injector face. Plotting routines have been written which will be used to see isobars and vector fields in this geometry. Some preliminary results have been obtained at this time but are too incomplete in nature to present.

#### II. Droplet Evaporation and Combustion Analyses\*

#### A. The Rate of the N2H4/N2O4 Reaction

It will be recalled that in order to utilize the modified flame surface analysis of Peskin and Wise (Ref. 1), some estimate is required of the overall (i.e., 'global') reaction rate constant for the  $N_2H_4/N_2O_4$  reaction (Ref. 2). That is, assuming the reaction proceeds according to

$$N_2H_4 + NO_2 \xrightarrow{k_f} \frac{3}{2}N_2 + 2H_2O$$
 (1)

some estimate of  $k_f$  is required. (NO<sub>2</sub> is considered the oxidant rather than N<sub>2</sub>O<sub>4</sub> as a result of the high level of dissociation of the latter under most engine operating conditions.)

This estimate can be obtained from the streamtube analysis developed in Ref. 2, wherein the relevant equations and assumptions are detailed. For reference purposes, the streamtube equations are summarized here as well:

#### Energy Conservation

$$\frac{dh}{dt} = 0$$
,  $h = constant$  (2)

#### Species Conservation

$$\frac{\mathrm{d}Y_{i}}{\mathrm{dt}} = \frac{r_{i}}{\rho} \tag{3}$$

#### Equation of State

$$\rho = \frac{pM}{RT} \tag{4}$$

<sup>\*</sup> Figures in this section again start with the number 1.

#### Auxiliary Equations

$$h = \sum_{i} Y_{i} h_{i}$$
 (5)

$$M = \left(\sum_{\underline{i}} \frac{Y_{\underline{i}}}{M_{\underline{i}}}\right) - 1 \tag{6}$$

$$h_{i} = \Delta_{i} + \bar{c}_{p_{i}} (T - \bar{T}_{REF})$$
 (7)

where  $h_i$  = enthalpy (sensible plus chemical) of species i

 $r_i$  = rate of appearance (or disappearance) of species i

 $Y_i$  = mass fraction of species i

 $M_i$  = molecular weight of species i

 $\rho$  = mass density of the gas mixture

p = pressure of the mixture

T = temperature of the mixture

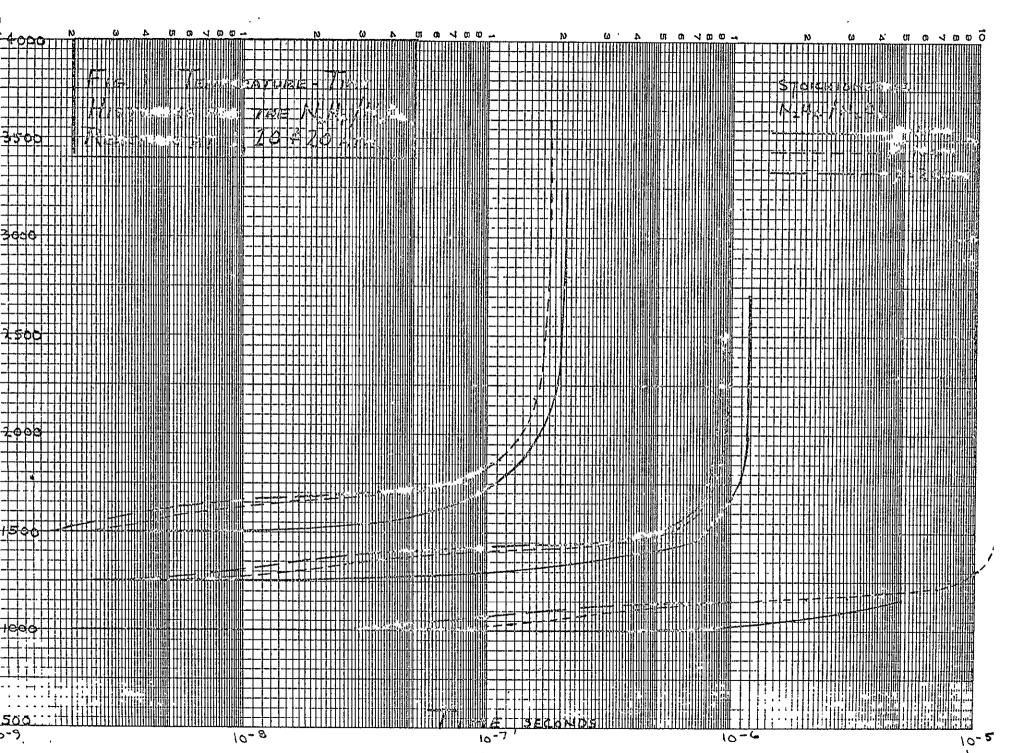
 $\Delta_i$  = reference enthalpy of species i

 $\bar{c}_{p_i}$  = average specific heat of species i

 $T_{REF}$  = reference temperature (1000°K)

t = time

Preliminary results were shown in Ref. 2. More complete results are presented in figure 1. Defining the ignition delay time ( $t_{\rm ID}$ ) qualitatively as the time required for the principal oxidation reactions to occur, figure 1 yields the anticipated result that  $t_{\rm ID}$  is a strong function of the initial mixture temperature. On the other hand, these results indicate that in the range examined,  $t_{\rm ID}$  is nearly independent of the pressure. As can be seen, at the higher pressures, the second-order reactions (which become more significant at higher pressures) produce an initial partial oxidation which results in a slight temperature increase. However, a leveling-off period is seen to subsequently



occur, followed by the <u>principal</u>, <u>first-order</u> oxidation processes which drive the reaction to completion.

As a result, the reaction may be said to be first-order, with ignition delay times (taken from figure 1) as shown in figure 2. In this latter figure,  $T_{\bf i}$  is the initial mixture temperature. The approximate straight line behavior of  $\ln t_{\rm ID}$  when plotted against reciprocal initial temperature is in accordance with elementary chemical kinetic thoery which predicts a faction of the form

$$t_{ID} = \alpha \cdot \exp (E/RT_i)$$
 (8)

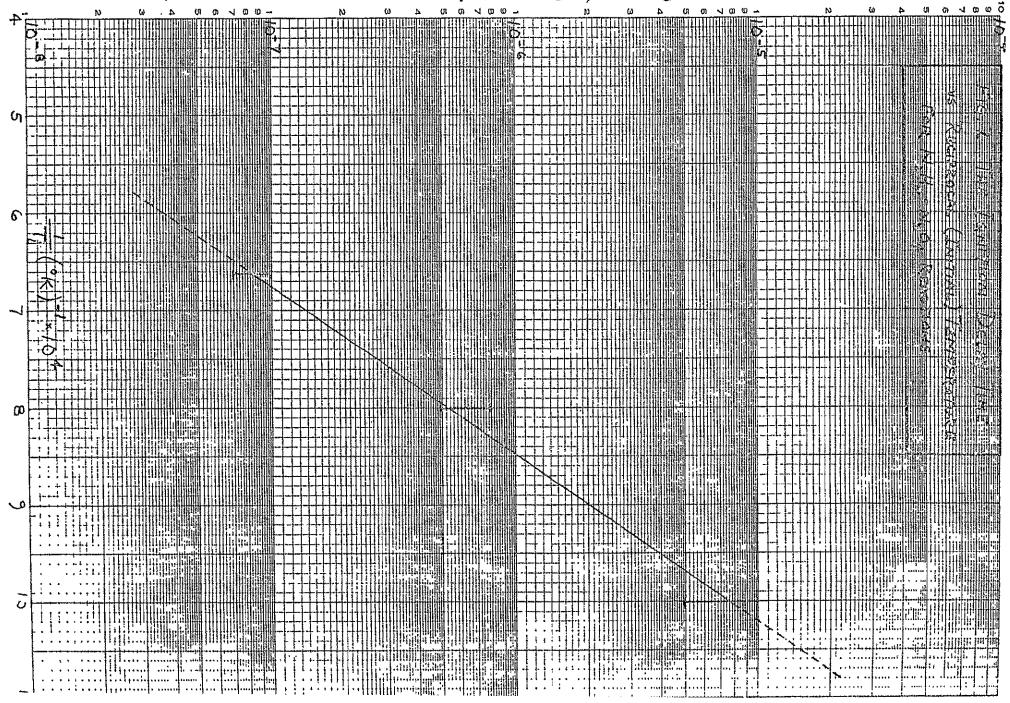
where  $\alpha$  is a constant and E is an overall activation energy. From figure 2, E was determined to be about 26,800 calories/mole.

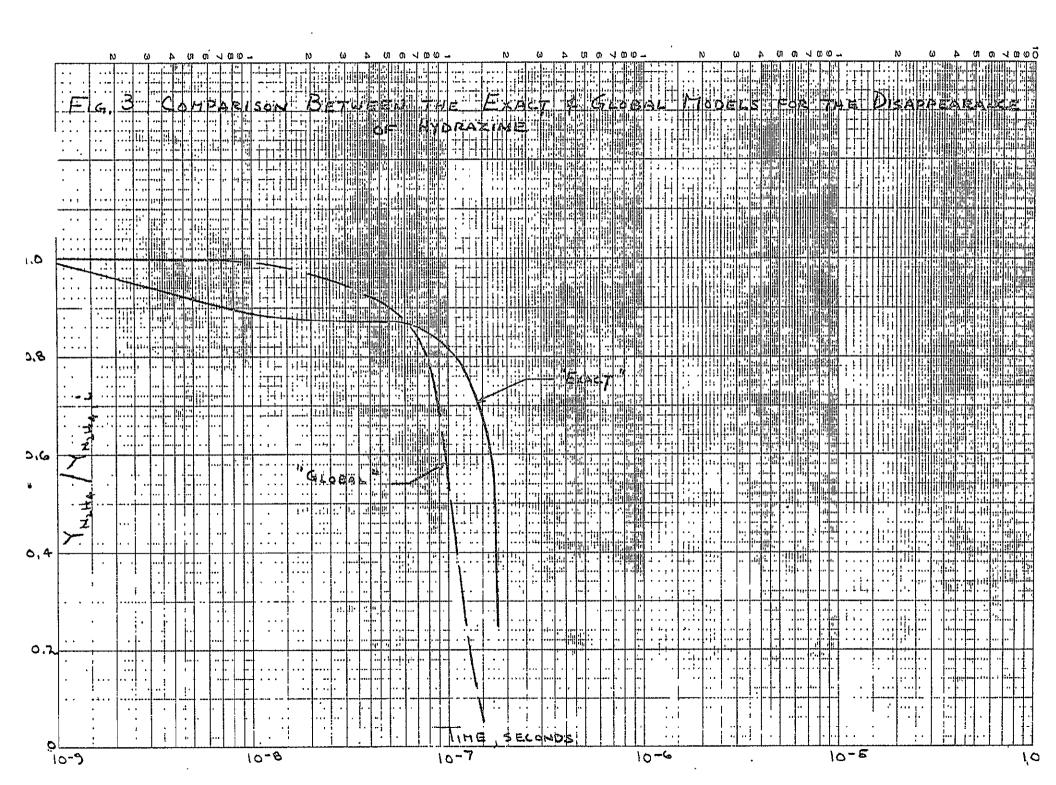
As an initial estimate, the pre-exponential factor in the overall reaction rate constant was chosen to be the average of the pre-exponential factors for the  $N_2H_4$  oxidation reactions as deduced by Sawyer (see Ref. 2, Table I). From this and the result obtained above, the initial estimate of the overall reaction rate constant was

$$k_f = 1.2 \times 10^{10} \exp (-26,800/RT)$$
 (9)

To check this estimate, results using eq. 9 were checked against results obtained using the complete streamtube analysis. The comparison was made at high pressure (20 atm), where the first-order approximation and eq. 9 would be least accurate. The results are shown in figure 3, with the streamtube result labeled 'exact'. The global model does not, of course, predict the initial reactions or the leveling off period after the initial second-order.

IGNITION DELAY TIME ( tID), SECONDS





reactions have occurred, but the general behavior and the delay time appears to be reasonable. Although the result for this particular case could have been improved by adjustment of the preexponential factor in eq. 9, this was felt to be unwarranted, and eq. 9 was selected as a suitably accurate overall reaction rate constant for inclusion in the modified flame surface analysis.

## The Modified Flame Surface Analysis

Under the assumptions inherent in the mourised flame surface analysis, as detailed in Refs. 2 and 3, the species conservation and energy equations were shown to reduce to

$$a\frac{dY_{i}}{d\eta} - \frac{d}{d\eta} \qquad \left(\eta^{2} \quad \frac{dY_{i}}{d\eta}\right) = -i_{i} \quad \eta^{2}_{b} \quad Y_{F}^{N_{F}} \quad Y_{O}^{N_{O}}$$
(10)

$$a\frac{dt}{d\eta} - \frac{d}{d\eta} \left( \eta^2 \frac{dt}{d\eta} \right) = \eta^2 b Y_F^{N_F} Y_O^{N_O}$$
(11)

where a = dimensionless mass burning rate =  $\dot{m}_F^{O}/(4\pi r_D k/c_D)$ 

mp = mass burning rate in stagnant surrounding

 $r_D$  = fuel droplet radius

k = thermal conductivity

 $\eta = r/r_D$ 

 $i_i = v_i M_i / v_F M_F$ 

 $v_i$  = stoichiometric coefficient of species i

 $N_{\rm F}$  ,  $N_{\rm O}$  = reaction orders with respect to fuel and oxidizer

 $b = k_f r_D^2 / D$ 

D = binary diffusion coefficient

 $t = (T-T_{\infty})/(Q/c_{p})$ 

Q = heat of reaction

 $T_{\infty}$  = temperature in the ambient gas mixture

On the basis of the conclusions drawn in the previous section,  $N_{\rm O}=0$  and  $k_{\rm f}$  is given by eq. 9. When eq. 10 is written first for the fuel and then for the oxidizer, and the resulting equations subtracted, an integrable ordinary differential equation results

subject to the following boundary conditions:

$$\begin{array}{lll} \frac{d}{d\eta} & Y_O & \eta = 1 & = a & Y_O \\ & & & \\ \frac{d}{d\eta} & Y_F & & = a & Y_F & -a \\ & & & \\ Y_F & & & = 0 & & \\ \end{array}$$

When eq. 10 written for the fuel is added to eq. 11, another integrable ordinary differential equation results subject to these boundary conditions:

$$\frac{dt}{dn} = \frac{L}{Q} a$$

$$t \int_{\eta \to \infty} = 0$$

The resulting equations can be manipulated to yield the following expression for the dimensionless mass burning rate:

$$a = \ln \left[ \frac{1 - \frac{L}{Q} + t_s}{1 - \frac{L}{Q} - Y_{F,s}} \right]$$
(12)

where L = latent heat of vaporization of the fuel

ts = dimensionless droplet surface temperature

 $Y_{F,S}$  = mass fraction of fuel at the droplet surface

We now introduce the additional assumption that the flame zone of finite thickness can be replaced by an infinitessimal on represented by a Driac-delta function located such that the fuel and oxidant react stoichiometrically. As a consequence, the righand-sides of eqs. 10 (written for the fuel) and 11 become

$$\eta^2_b Y_F^* \cdot \delta(\eta - \eta^*)$$

where the asterisks refer to the values at the hypothetical flame surface, and  $\delta$  is the delta function: (Note that the fact that  $N_O=0$  has been used in writing this term.)

Peskin (Ref. 1) shows that a solution to equation 10 with this right-hand-side is given by generalized function theory as

$$Y_{F} = \frac{b^{*}}{a} Y_{F}^{*} \eta^{*2} e^{-a/\eta} \begin{cases} 1 - e^{a/\eta} & \text{for } \eta > \eta^{*} \\ 1 - e^{a/\eta^{*}} & \text{for } \eta < \eta^{*} \end{cases} + 1 - e^{-a/\eta}$$
(13).

Therefore, for  $\eta=\eta^*$ ,  $Y_F=Y_F$  and eq. 13 becomes

$$Y_{F}^{*} = \frac{(1-e^{-a/\eta^{*}})}{1+\frac{b^{*}}{a}\eta^{*2}(1-e^{-a/\eta^{*}})}$$
(14)

Now when eq. 13 is solved for  $\eta \! = \! 1$  ,  $Y_{\rm F} \! = \! Y_{\rm FS}$  , and eq. 14 is used, the result is

$$Y_{FS} = \frac{\frac{b^*}{a} \eta^{*2}}{1 + \frac{b^*}{a} \eta^{*2} (1 - e^{-a/\eta^*})} (1 - e^{-a/\eta^*}) + 1 - e^{-a}$$
(15)

From the difference between eq. 10 written for the fuel and the oxidizer, and using the appropriate boundary conditions, the following expression is obtained for  $\eta^*$ :

From the sum of equations 10 (written for the fuel) and 11, again subject to the appropriate boundary conditions, the following expression can be derived for t\*:

$$t^* = \frac{({}^{Y}_{FS} + {}^{t}_{S}) (e^{-a/\eta^*} - 1)}{e^{-a} - 1} - \frac{(1 - e^{-a/\eta^*})}{1 + \frac{b^*}{a} {}^{\eta^*} {}^{2} (1 - e^{-a/\eta^*})}$$
(17)

in which equation 14 was also used.

Finally, using the result of the previous section, b\* can be written

$$b^* = \frac{r_D^2}{D} \quad \left[ 1.2 \times 10^{10} \cdot \exp(-26,800/RT^*) \right]$$
 (18)

Equations 12, 15, 16, 17, and 18 constitute five equations in the five unknowns a,  $Y_{FS}$ ,  $\eta^*$ ,  $T^*$ , and  $b^*$ . (Unlike Peskin (Refs. 1, 4, 5), we are not interested here in species and temperature profiles surrounding the droplet, but in the mass burning rate a; as a consequence, the equations developed above are particularly suited to this purpose.)

Results using this analysis have been obtained for the following values of the parameters:

$$Y_{O}(\infty) = 0.25$$

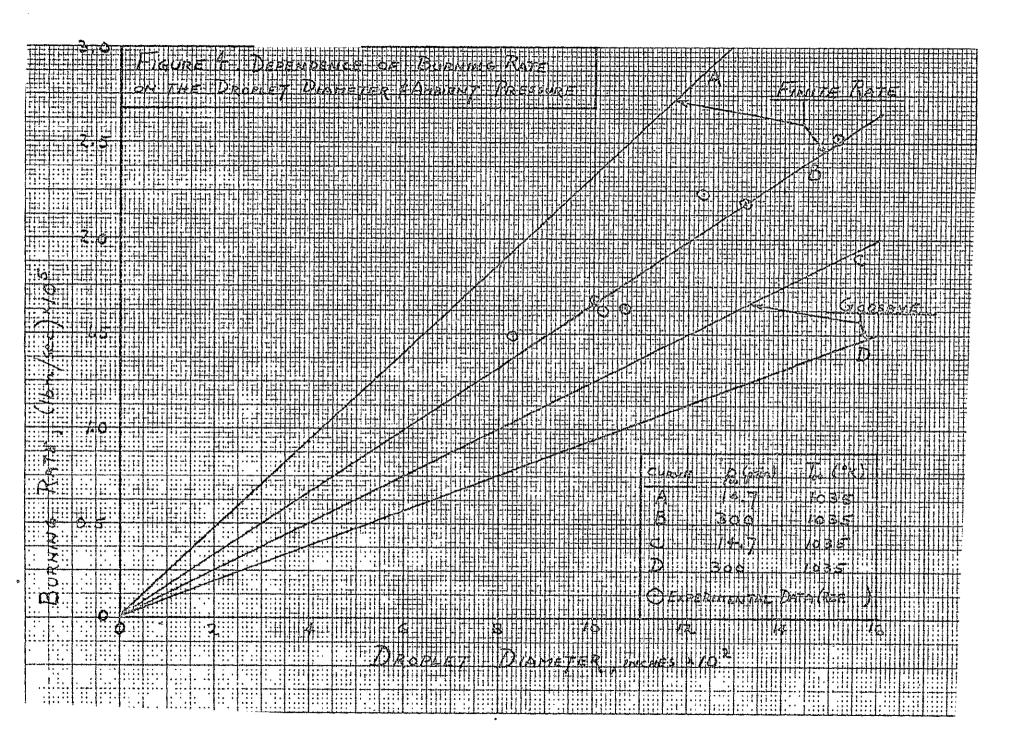
$$D = 10^{-4} \frac{ft^{2}}{sec}$$

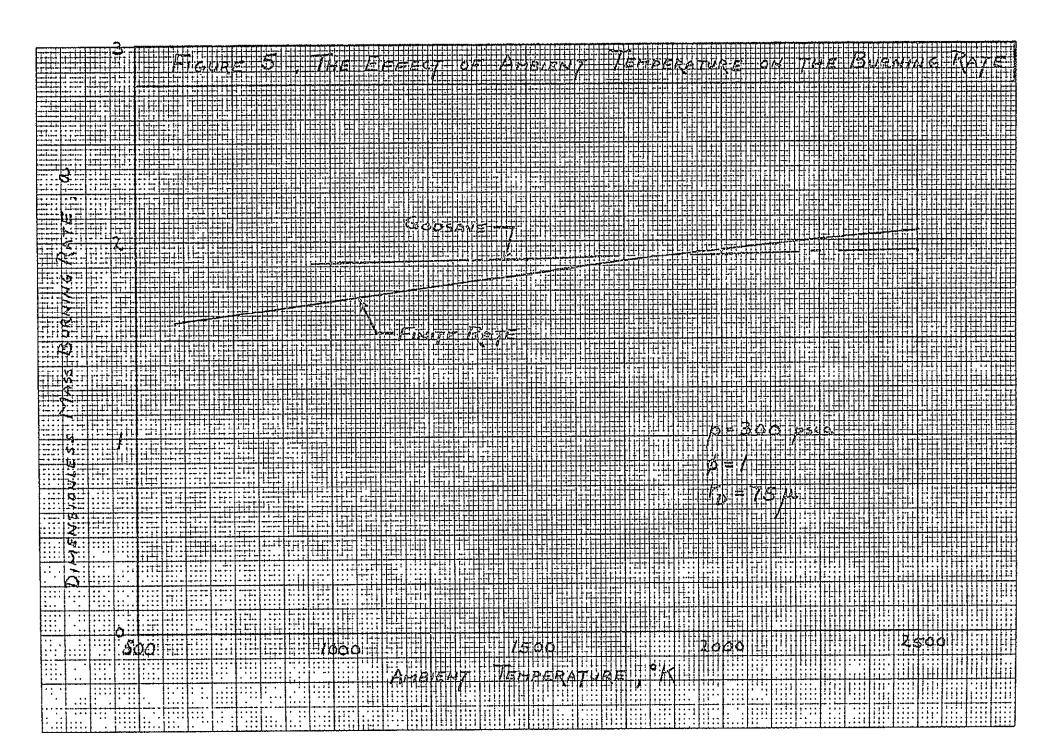
$$i_{O} = \frac{23}{16} \text{ (see eq. 1)}$$

Q was calculated from the enthalpies obtained from eq. 7; L was obtained from the Clausius-Clapeyron equation using the vapor pressure data in Ref. 6; in going from a to  $\dot{m}_F^O$ , k was obtained from Ref. 6 and  $c_p$  from Ref. 7.

Results are shown in figures 4, 5, and 6. In figure 4, the results are compared with the previous results obtained from the Godsav analysis (Ref. 2) and the experimental results of Ref. 8. As can be seen, the current analysis yields results which are about 80% higher over most of the range of  $r_D$  than the corresponding Godsav value. This is due, at least in part, to the values chosen for  $Y_O(\infty)$  and D, as well as the differences inherent in the two approaches. It is interesting to note, however, that the line corresponding to  $T = 1035^OK$ , P = 300 psia (Curve B) passes right through the experimental points of Ref. 8. Unfortunately, Ref. 8 does not indicate the level of pressure at which these experiments were conducted, leaving this possible correlation unresolved. However, the linear dependence of the burning rate on droplet diameter is retained by the modified flame surface analysis, in accordance with the experimental results.

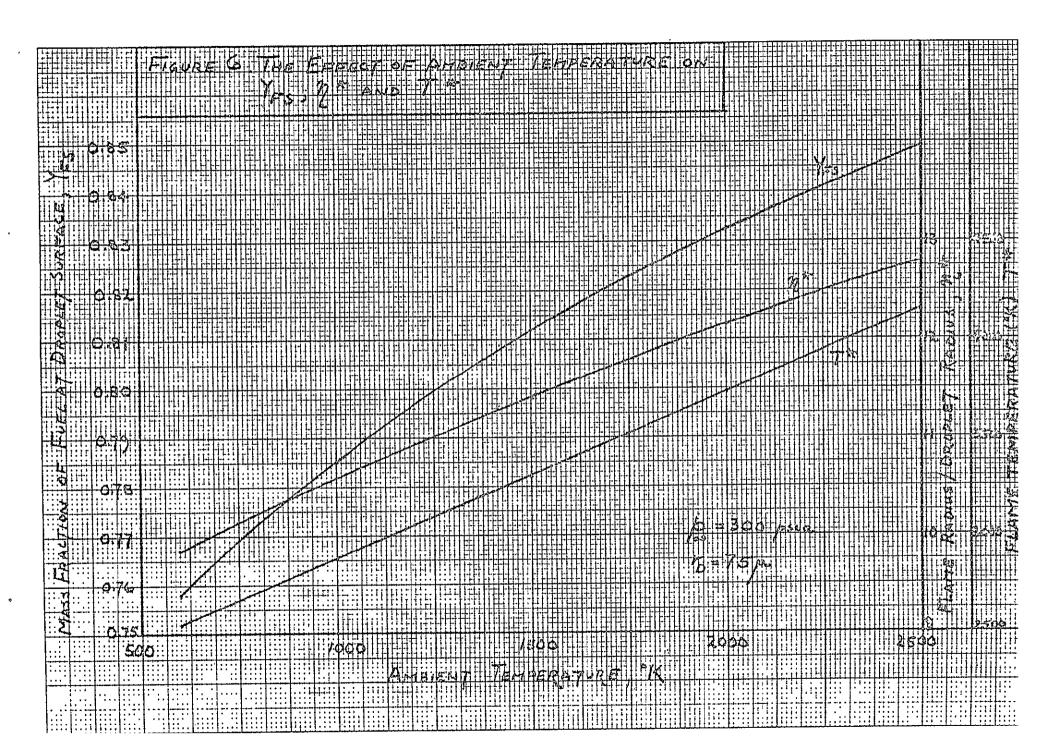
Figure 5 contrasts the ambient temperature dependence of this analysis and the Godsav analysis for the particular conditions noted. It was pointed out in Ref. 2, and can be seen in figure 5, that the Godsav analysis yields a very weak, almost linear ambient temperature dependence. Most experimental work indicates a stronger, non-linear dependence. The modified flame surface analysis does yield this latter type of dependence. It may be justifiably said, however, that the differences between the two analyses at these particular conditions are not sufficiently great to warrant using the current analysis in the fluid dynamics program. In particular, no evidence of extinction can be seen down





to ambient temperatures near the boiling point of the fuel. If this same result is discovered at other values of the ambient pressure as well, this will constitute ample justification for the use of the simpler Godsav analysis.

The effect of ambient temperature on the values of  $Y_{FS}$ ,  $n^*$  and  $T^*$  are shown in figure 6. The value of  $Y_{FS}^{-1}$  as  $T_{\infty}$  increases, in accordance with the assumption of the Godsav, diffusion-flame approximation  $(Y_{FS=1})$ . The hypothetical flame surface moves away from the droplet as  $T_{\infty}$  increases; this stems from the fact that in order to sustain a stoichiometric combustion process, the flame location must move away from the flame surface where a larger quantity of fuel vapor  $(Y_{FS})$  is being produced. Finally,  $T^*$  exhibits a linear dependence on  $T^*$ 



## C. The Reduced Godsav Analysis

Preliminary runs which coupled the complete Godsav analysis to the fluid dynamics program indicated that the running times were excessively long. (Roughly, five times slower than with the elementary energy term previously used.) As a consequence, the results obtained to date from the Godsav analysis (Ref. 2) were used to formulate the following simplified version of this analysis:

The weak, almost linear, temperature dependence of the dimensionless mass burning rate can be approximately expressed as

$$a_{300} = (3.73 \times 10^{-5}) (T_{\infty}) + 1.855$$
 (19)

where  $a_{300}$  is the dimensionless burning rate at a chamber pressure dependence is approximately given by

$$\frac{a_{p}}{a_{300}} = \begin{pmatrix} p_{\infty} \\ 300 \end{pmatrix} \quad 0.0108 \tag{20}$$

Once  $a_p$  is computed, the burning rate in stationary surrounding: is obtained from

$$\dot{m}_{F}^{O} = \frac{2\pi k}{c_{p}} d_{L} a_{p}$$
 (21)

where  $\mathbf{d}_{L}$  is the drop diameter, and the thermal conductivity and specific heat are functions of the liquid drop temperature.

The drop temperature,  $T_{\rm L}$ , which is the boiling temperature at the chamber pressure, can be obtained to a good approximation from the integrated Clausius-Clapeyron equation

$$\ln \frac{p}{2131} = (8.7 \times 10^3) \left( \frac{1}{1176} - \frac{1}{T_L} \right)$$
 (22)

where p is in psia,  $T_{\rm L}$  is in  $^{\rm O}R,$  and the critical point conditions are 2131 psia, 1176  $^{\rm O}R.$ 

Knowing  $T_{\rm L}$ , K is obtained from a linear curve fit of the data in Ref. 6:

$$K = \frac{1}{3600} \left[ (-8.33 \times 10^{-5}) (T_{L} - 460) + 0.2107 \right]$$
 (23)

and  $c_p$  is obtained from Ref. 7:

$$c_p = 0.138 + 0.527 \times 10^{-3} T_L - 0.120 \times 10^{-6} T_L^2$$
 (24)

From  $\dot{m}_{\rm F}^{\rm O}$ , the burning rate in the convective environment is then obtained from (see Ref. 3, eq. 21):

$$\frac{\dot{m}_{\rm F}}{\dot{m}_{\rm F}} = 1 + 0.276 \, (\text{Re})^{\frac{1}{2}} \, (\text{Pr})^{\frac{1}{3}}$$
 (25)

Under the engine conditions of interest, the following constant values are reasonable:

$$Pr^{1/3} = 0.6$$

$$L_F = 540 \frac{Btu}{Lbm}$$

$$L_O = 178.2 \frac{Btu}{1bm}$$

$$Q = 12,400 \frac{Btu}{1bm}$$

where  $L_F$  is the latent heat of the fuel,  $L_O$  is the latent heat of the oxidizer, and Q is the heat of reaction. The appropriate terms in the  $\psi$ -vector of the fluid dynamics program may now be obtained as shown in Ref. 3 (eq. 22). Results obtained using this approximate formulation are shown elsewhere in this report.

## REFERENCES

- 1. Peskin, R. L. and Wise, H., AIAA Journal, 4, 1646 (1966)
- 2. Burstein, S. Z. and Chinitz, W., "Nonlinear Combustion Instability in Liquid-Propellant Rocket Motors", 2nd Quarterly Report, Mathematical Applications Group, Inc. January 30, 1968.
- 3. IBID, 1st Quarterly Report, October 30, 1967.
- 4. Peskin; R. L., et.at., AIAA Journal, 5, 2173 (1967).
- 5. Polymeropoulos, C. E. and Peskin, R. L., "Theoretical Calculations of Fuel Drop Ignition and Extinction", Paper USCI-67-5, Western States Section/The Combustion Institute, April, 1967.
- 6. Aerojet-General Corporation Report on Properties of Propellants
- 7. Haws, J. L. and Harden, D. G., J. Spacecraft and Rockets 2, 972 (1965).
- 8. Dynamic Science Report No. SN-95-4, Monthly Progress Report under Contract No. NAS7-567, 1967.